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A Comparison of Intellectually Normal Children, Mentally Retarded Adolescents, and Mentally Retarded Adults on A Three Dimensional Concept Formation Sorting Task

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A COMPARISON OF INTELLECTUALLY NORMAL CHILDREN, MENTALLY RETARDED ADOLESCENTS, AND MENTALLY RETARDED ADULTS ON A THREE DIMENSIONAL CONCEPT FORMATION SORTING TASK

by

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ABSTRACT

A Comparison of Intellectually Normal Children, Mentally Retarded Adolescents, and Mentally Retarded Adults on A Three Dimensional Concept Formation Sorting Task

by

James C. Kamprud, Doctor of Education

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Major Professor: Dr. Helmut Hofmann
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The purposes of this study were: (1) to compare nine groups of subjects composed of intellectually normal children, mentally retarded adolescents, and mentally retarded adults on a three dimensional concept formation task; (2) to determine the effects of discrimination training on the sortings of the nine groups on the experimental task.

The 207 subjects of this study were divided into nine groups. Seven of the groups, consisting of high average and low average grade 3, superior high average, and low average grade 6, and high and low adolescent retardates were chosen on the bases of school grade level (3, 6, and adolescent retarded) and IQ level (low average, high average, superior, low and high adolescent, and low and high adult retarded) with each group composed of 21 subjects, except the two adolescent groups which were composed of 30 subjects each. The remaining two groups, high and low adult retardates, were chosen on the bases of chronological age (between 20-35) and IQ level (high and low mildly retarded), with both groups composed of 30 subjects. One-third of the subjects in each group were given special discrimination training with the task objects.

The experimental task required each subject to place 27 objects in three trays which could be moved back and forth. The trays were stacked one on another vertically but separated by one-sixteenth of one inch. Each tray was divided into nine boxes.

The objects were of three kinds: sphere, cube, and tetrahedron; three sizes: 1, 1 1/2, and 1 3/4 inches; and three shades of blue: dark, medium, and light. Each subject was directed to place the objects in the three dimensional matrix as he desired. The discrimination subjects of each group performed the same task, but they received special orientation training with the trays and objects. One task object, a medium sized, medium blue cube was pre-placed in the center box of the middle tray for an anchor point for each subject to use for his sortings.

The results of this study indicate the following:

1. The nine diverse groups included in this study did not show statistically significant differences in their grouping of identical color shades, identical forms and identical sizes in the three dimensional matrix when each element (color, form and size) was considered separately across all of the nine groups. This lack of significance among all of the groups was also true for sorting different color shades, different forms, and different sizes. The above findings apply to the horizontal and the vertical sortings within the three dimensional matrix.

2. The nine groups did not significantly (statistically) differ in their use of the left to right direction in their grouping of identical color, identical form, and identical size horizontally as well as vertically. This lack of significance also applied to the use of the front to back direction in sorting color, form and size differences both

horizontally and vertically.

3. Discrimination training did not significantly affect the performance of the nine groups on any of the dimensions measured in this study. Adult and adolescent retarded groups showed noticeable effects from discrimination training by increasing their responses to size likenesses in their horizontal sortings. In general, normal subjects increased their groupings of identical elements more than retarded subjects, but the findings indicate that IQ and chronological age did not significantly (statistically) affect discrimination training in these nine groups.

4. Neither chronological age nor IQ significantly (statistically) affected the subjects' concrete tendency to place the largest size objects into the top tray which was most accessible for sorting.

(164 pages)

INTRODUCTION

The study of concept formation and cognition in general has received increasing consideration in the field of psychology in recent years. Bruner (1962) regards this increasing interest as a "revival":

> The past few years have witnessed a notable increase in and investigation of the cognitive processes--the means whereby organisms achieve, retain, and transform information. This increase in interest and effort could, we suppose, be counted as a "revival" since there was an earlier time (the years before the first World War), when the Higher Mental Processes constituted a core topic within psychology. (Bruner, 1962, p. vii)

The basis for the "revival" are obvious to Bruner:

> One need not look for the origins of the "revival." Partly, it has resulted from a recognition of the complex processes that mediate between the classical "stimuli" and "responses" out of which stimulus response theories hoped to fashion a psychology that would bypass anything smacking of the "mental." The impeccable peripheralism of such theories could not last long. As "S-R" theories came to be modified to take into account the subtle events that may occur between the input of the physical stimulus and the emission of an observable response, the old image of the "stimulus response bond" began to dissolve, its place being taken by a mediation model. As Edmund Tolman so felicitously put it some years ago, in place of a telephone switchboard connecting stimuli and responses it might be more profitable to think of a map room where stimuli were sorted out and arranged before every response occurred, and one might do well to have a closer look at these intervening "cignitive maps." (Bruner, 1962, p. viii)

Bruner also gives due credit to personality theorists for the "revival" in cognition:

> Cognitive theory was at first of interest to the personality theorist only to the degree to which "rational" processes could be made captive of impervious drives and defenses. Psychoanalysis and personality theory generally have become increasingly interested in what has come to be called "ego psychology," and the so called synthetic functions of the ego grow more and more central. As the ego came out of hiding, the interest in cognitive functioning came in. If the work that came to be called the "New Look" in perception started off searching for manifestations of autism in perceiving, it soon became transformed into a search for links between general laws of perception and cognition on one side and general laws of

personality functioning on the other. (Bruner, 1962, p. viii)

It is apparent from Bruner's comments that the renewed interest in cognitive psychology was needed and long overdue, but as will be mentioned in the following section it is only beginning.

Need for the Study

Studies of concept formation with the mentally retarded have, in general, used simple two dimensional sorting tasks such as the Goldstein-Scheerer Color Form Test and the Goldstein-Scheerer Object Sorting Test. These studies have been justly criticized for not employing more difficult tests for their experimental tasks. Zaslow (1961) developed his own experimental task for measuring concepts in the retarded because he considered the Goldstein-Scheerer tests inadequate for the following reasons:

1. They lack an objective scoring system.
2. They are too simple and are usually failed only by more severe psychotics and more severe types of brain damaged patients.
3. They stress the principle of identity as a basis of categories. There is no variation in the elements. Once an element is isolated the entire category is formed.

Stone (1966) also considered such tasks as limiting factors in studying concept formation. He considered the study of the relationship between color, form and size studied concurrently more important:

> For purpose of this study, color, form and size labels are taken to be less complex than observations regarding relations existing when size, color and form are to be used concurrently. (Stone, 1966, p. 2.1)

Stone emphasized another need in understanding cognitive processes: more studies in concurrent generalization.

> Lack of literature is stressed by Karplus in the 1964 Piaget conference. A considerable amount of literature is developing on the basic categorization process, on semantic generalization, on verbal mediation and verbal shifts due to language control, but studies of concurrent categorization the present study , and of formal (in the Piagetian sense) systems is only beginning. (Stone, 1965, p. 2.1)

The writer has discovered that the need for literature in concurrent categorization still exists. Only Stone has used this approach, and his study included only intellectually normal subjects.

The present study corrects the objectionable features of the Goldstein-Scheerer tests, expressed by Zaslow, by using a three dimensional problem simplified from Stone's more difficult one. This simplification decreased the number of objects from 56 to 27 and number of instances (object dimensions) from 6 to 3. This reduction in stimuli was considered necessary for studying retardates. The responses of the test were scored by an objective scoring system which provided a basis for reliability.

Organization of the Study

This study consists of the following six parts:

I. Introduction. A brief background related to the problem, a need for the study and organization of the study are included.

II. Review of Literature. A broad segment of the field of learning as it pertains to the mentally retarded including summary of research from 1904 to 1964; abilities of the mentally retarded measured by psychometric data; perceptual abilities of the mentally retarded; serial verbal learning of the mentally retarded; paired associate learning of the mentally retarded; object discrimination learning of the mentally retarded; delayed reaction learning of the mentally retarded;

incidental learning of the mentally retarded; the roles of transfer and generalization of mental sets in the learning of the mentally retarded; the roles of reinforcement and incentives in learning of the mentally retarded; the role of rigidity in the learning of the mentally retarded; stages of cognitive development; concept formation behavior of the mentally retarded; and number and space concepts of the mentally retarded.

III. Research design. A description of the study including the relation of this design to previous studies; description of subjects; methods and procedures; statement of the objectives; limitations of the study; source of data; and data analysis.

IV. Analysis of data and findings. A description of the results of the study.

V. Discussion. An interpretation of the findings and their implications.

VI. Summary and conclusions. A brief summary of the entire study, and conclusions, including the educational implications of this study.

Summary

The study of cognition has experienced a "revival" in recent years. Its decline after World War I has been credited to the popularity of "S-R Theories." Its revival has been credited to the modifications that have occurred in "S-R Theories" in attempts to explain the subtle events that occur between input and emission of the response and the advent of "ego psychology" in personality theory.

A need for more experimental literature in concept formation is clearly evident, especially with the mentally retarded. Past studies in concept formation with the retarded have not used experimental tasks that

measure concurrent generalization; they have only, in general, used simple sorting tasks involving color and form. The present study includes a second element new to a study of concept formation with retardates, a three dimensional sorting matrix.

REVIEW OF LITERATURE

This review of literature includes not only studies of concept formation with the mentally retarded, but also studies that encompass a supportive segment of the field of learning. This approach was considered appropriate because an introduction to learning characteristics of the retarded should prepare the reader for a better understanding and appreciation of the study in general.

It is commonly believed that the mentally retarded are inferior to the intellectually normal in acquiring information and skills and in learning material of increasing complexity. McPherson (1947) investigated the validity of this belief by reviewing pertinent research published between 1904 and 1947. Her review only included studies which used psychometric data as criteria. She defined her criterion for learning by stating, "Learning is the improvement in performance resulting from repetitive practice in response to stimuli held constant throughout the learning period." (McPherson, 1947, p. 232) In summary of her entire review, McPherson stated the following:

> In summary, the outstanding impression gained from this review of learning in the subnormal is one of lack of information. The actual experiments have been few, the number of subjects small, the tasks learned heterogeneous within a narrow range, and the motivational factors inadequately controlled. (McPherson, 1947, p. 252)

McPherson's important summaries provided an awareness for the need for more and better research. Since the beginning of the 1950's, research in the field has increased in quantity and quality. Before reviewing these studies, a few comments concerning the applicability of their results should be helpful to the reader. Woodrow (1946) forcefully

summarized his opinions on this topic in the following manner.

> It is doubtful whether any abilities can be defined except in terms of task accomplishment. Our information concerning the nature of any ability will for a long time to come, consist in a set of correlations between the ability and a list of other variables.
>
> . . . . . .
>
> Experiments in classrooms and laboratories in which improvement by practice has been measured are all contradictory with the assumptions that improvements with practice is identical with intelligence. The ability to learn cannot be identified with the ability known as intelligence.
>
> . . . . . .
>
> Individuals possess no such thing as a unitary general learning ability. (Woodrow, 1946, p. 148)

Abilities of the Mentally Retarded Measured by Psychometric Tests

Baroff (1959), Newman and Loos (1955) and Sandercock and Butler (1952) discovered that familial retardates performed significantly better on performance than on verbal items of the Wechsler Intelligence Scale for Children.

In studies with the Stanford-Binet tests, Sloan and Cutts (1947) found items requiring abstraction ability more difficult for retardates than items requiring concrete ability. Thompson (1947) and Thompson and Margaret (1950) reported that test items heavily loaded with the "g factor" and items requiring rote memory were more difficult for retardates than normals. Thompson's (1947) hypothesis that easier items would be simpler for older retardates because such items are dependent upon practical experience was not sustained.

Meyers' et al. (1961) comparison of retarded and normal groups matched on mental age 6, indicated retardates superior on items requiring simple information and expressive vocabulary, but inferior on items requiring abstraction, rule forming, translation of codes, hand-eye

coordination and perceptual speed. Retardates scored lowest on digit span and items requiring non-verbal reasoning.

Perceptual Abilities of the Mentally Retarded

Leibowitz (1961) found no significant differences in retarded and normal subjects in judging which of two block figures was longer when viewed down a well illuminated hall; but in another study his results indicated that shape matching was significantly related to intelligence (Leibowitz, 1959). Zuk (1959) discovered that under conditions requiring memory, retardates had gross figural distortions in their reproductions and reproduced shorter figures than normals.

Berkson (1959) concluded that retardates had lower duration thresholds than normals on a light recognition experiment, and Ware et al. (1962) considered their performance equal to normals on a task requiring the detection of interruptions in a continuous light. With knowledge of results the retardates improved their previous performance on the light detection task.

Merachnik's (1961) study revealed that age, sex, or type of retardation did not influence ability to discriminate among small color saturation differences but that retardates were inferior to normals on these tasks.

Berkson's (1959) normal adolescent group had shorter visual reaction times than his retarded group. Pryor (1959) indicated no significant relationship between errors on a depth perception test and mental age and IQ.

In studies comparing exogenous and endogenous retardates, McMurray (1954) found that exogenous subjects saw less figure-ground reversals

than endogenous retardates. Hunt (1960) discovered retardates with severe brain damage inferior to familial and minimal brain damaged retardates in answering questions about phonograph records they had listened to.

Hoats et al. (1963) detected significantly less perceptual curiosity in retardates than in normals of equal chronological age.

Verbal Mediation of the Mentally Retarded

Several studies have concluded that verbal mediation occurs in the retarded. Osborn 91960) found that familial and organic retardates cluster significantly more than retardates. Rossi (1963) discovered that higher mental age retardates used significantly more superordinates in word clustering than lower mental age retardates. When Jensen and Rohwer (1963) presented retardates with sentences relating objects, they found increased learning and retention in retardates. Berkson and Cantor's (1960) paradigm A-B, B-C with Arabic numerals facilitated the learning of A-C in retardates. Griffith and Spitz's (1958) study qualified the retardate's verbal mediation ability in their conclusions:

> If retardates actively tested hypotheses in attaining abstractions, they would presumably have little difficulty in achieving an abstraction when the correct property was associated with anyone of the three words in a triad. The fact that a majority of words, two or more, must evoke the correct property for our S's to have much success in concept attainment suggests they infrequently operate in this manner. (Griffith and Spitz, 1958, p. 250)

Serial Verbal Learning of the Mentally Retarded

Ellis et al. (1960) found serial verbal learning on a memory drum substantially related to IQ with retardates learning twice as slow as average and superior subjects.

Barnett et al. (1960) reported that retardates made relatively more errors at the start of a verbal list and normals made more errors in the middle of the list.

Paired Associate Learning of the Mentally Retarded

The results of Ring and Palermo (1961) and Cantor and Ryan (1962) agreed that retardates and normals of equal mental age do not differ in learning retention of paired associate pictures, but when Rign and Palermo (1961) matched on chronological age they found retardates inferior to normals. Eisman (1958) disagreed by concluding no significant relationship between IQ and paired associate retention with retarded, average, and superior subjects. She suggested that her experimental task was too easy for differentiation.

Blue (1963) synchronized aurally presented color names with geometric designs flashed on a screen. He found that retardates took longer than normals to learn the pairings and that a combination of decreased and delayed auditory intensity reduced their learning.

Object Discrimination Learning of the Mentally Retarded

Ellis (1958) and House and Zeaman (1958) found that as mental age increased in retardates their performance on object discrimination tasks also increased. But Ellis (1959) and House and Zeaman (1958) discovered that at a mean mental age of four and below, retardates became inferior to intellectually normal subjects of the same mental age on such tasks. Ellis (1959) and Stevenson (1960) matched retardates and normals on mental age and found no significant differences between the groups on simple and complex object and pattern discrimination problems but when

Whiteside (1934) and Griffith (1960) used IQ to group retardates and normals, they found a positive relationship between IQ, object discrimination and recognition performance. Metzger (1960) discovered that higher mental age retardates had fewer stereotyped responses than lower mental age retardates on an object discrimination task but that stereotyped behavior was not significantly related to the etiology of retardation. de Haan and Wischner (1963) found photographs and object stimuli equally effective in establishing learning sets in retardates.

Delayed Reaction Learning of the Mentally Retarded

McCullough et al. (1955) reported mental age significantly related to initial scores (grasp) and repetition learning scores (gain) on a task requiring retardates to repeat lists of words back to the experimenter under delay conditions. Stolurow and Pascal (1950) obtained like results by finding a significant relationship between ability to delay on a double alternation problem and mental age and IQ. However, on an easier delay problem requiring retardates to remember which compartment candy was hidden in, Pascal and Stolurow (1951) found no such relationships.

Barnett et al. (1959) found that retardates who learned names for the delayed reaction stimuli performed significantly better than those who did not.

Incidental Learning of the Mentally Retarded

Goldstein and Kass (1961) compared retarded and gifted subjects by presenting them with pictures of common objects and instructing them to point out all 2's. To test for incidental learning, the subjects

required to recall and name details of the pictures from memory. Their results indicated that both retardates and gifted acquired incidental learning but in complex memory and giving details of the pictures, the retarded were inferior.

Baumeister (1963) conducted a study with retardates and average groups and found them equal in incidental learning but the retarded superior in intentional learning.

The Roles of Transfer and Generalization of Mental Sets in the Learning of the Mentally Retarded

Bensberg's (1958) study indicated that retardates build up implicit responses in training which influence their performance on a transfer task. He found that groups would perform in the following order, listed from best to poorest, on a transfer task requiring discrimination of form: a group pretrained on animal names; a group pretrained on color; a group pretrained on color with additional practice.

Barnett and Cantor (1957) with severely retarded, and Stevensen and Iscoe (1955) with retardates of mental age 7, found that pretraining on tasks similar to the transfer tasks facilitated transfer. Dickerson's (1963) hypothesis that retardates receiving training with identical objects would show superior ability to detect odd objects in another task was not sustained. When Kass and Stevensen (1961) matched retardates on mental age, they discovered that high success on pretraining games different from the transfer task facilitated learning for both retardates and normals. Smith and Means (1961) considered learning of names of cues and hand movements to cues superior to matching cues and learning nonsense syllables for cues, in learning transfer tasks.

Martin and Blum (1962) discovered intertest generalization with

oddity problems related to mental age rather than retardation. Barnett (1959) showed that "high training" on a pretraining task facilitated more stimulus generalization than "low pretraining" for both retardates and normals but he agreed with Eisman (1958) and Cantor and Ryan (1962) that retardates do not differ significantly from normals in amount of stimulus generalization.

The Roles of Reinforcement and Incentives in Learning of the Mentally Retarded

Heber (1959) lent credence to the Hullian hypothesis that better performance can be predicted on the basis of greater magnitude of reward by finding that a retarded group's performance on a performance task was significantly related to whether it was receiving "highly preferred incentives" or "less preferred incentives." Cantor and Hottell (1955) however, discovered that mildly and severely retarded subjects were not significantly affected by high and low magnitudes of rewards when "high reward" was three peanuts and "low reward" was one peanut.

Zigler and deLabry's (1962) results indicated that retarded and lower class children perform more effectively under tangible than intangible rewards. Ellis and Pryor (1958) and Hunt and Patterson (1957) discovered that performance was not significantly improved by candy reward when compared to no reward, but Hunt and Patterson (1957) found that candy plus verbal urging produced significant effects. Thompson (1963) concluded that reinforcement was not necessary to perceptual learning.

Gordon et al. (1955) reported self competition a better incentive than group competition in retention on performance tasks with severely retarded subjects.

Stevensen and Knight (1962) study showed that retardates require a longer period of satiation in supportive interaction with adults than do normals.

The Role of Rigidity in the Learning of the Mentally Retarded

Kounin's (1941) classic experiments in "rigidity" postulated that feebleminded individuals were less able to shift from one task to another because the boundaries within their life space are more rigid than those of intellectually normal individuals. His two general theories that "rigidity is a positive monotonous function of the degree of feeblemindedness" and that "rigidity is a positive monotonous function of chronological age" (Kounin, 1941, p. 252) gained confirmation by his experimental data. Spitz (1959) considered "rigidity" the result of "low satiation" on figure-ground relationships as an explanation for "rigidity" in retardates. Kaufman and Peterson (1958) and Siegel (1957) found that retarded subjects had more difficulty than normal subjects in shifting from one task to another. In agreement, Siegel (1957) found this true also of retardates when compared with schizophrenic and brain damaged subjects of average intelligence. McMurray (1954) discovered brain injured subjects significantly less able to "shift" mental sets than non-brain injured subjects with matched IQ's.

Zigler (1961) considered his experimental results as validity for his "social approval" hypothesis: "Rigid behavior observed in feebleminded subjects may be attributed to a higher motivation to maintain an interaction with an adult to secure approval through compliance." (Zigler, 1961, p. 42) Penney et al. (1962) gave some credence to Zigler's hypothesis by finding that retardates persevered more under

a continuous reward schedule but when the first task was learned under partial reinforcement retardates did not differ from normals in learning the habit reversal problem.

In disagreement with Kounin (1941), McMurray (1954), and Siegel (1957), Plenderleith (1956) found a large amount of positive transfer from discrimination to discrimination reversal under reward schedules in both retardates and normals and Stevenson and Zigler (1957) discovered retardates and normals equal in reversals when matched on mental age 5, and under reward. Stevenson (1960) concluded that rigidity is a condition due to problem difficulty not retardation.

Stages of Cognitive Development

Piaget's research indicates that cognitive abilities develop in a definite sequence. Siegel (1964) described them in the following manner.

The sensory-motor period

The first two years of life have been described by Piaget as the sensory-motor period. During this period, the infant develops from a reflexive organism to a relatively organized system through contact with the environment. His most important accomplishments during this period are: differentiating himself from other objects; localizing himself in space; and establishing an awareness of cause and effect and time and space. However, even as he moves to the end of this period, his perceptions are still dominated by the physical attributes of his environment.

The pre-operational period

During years two to four, the child approaches the period when he

can think symbolically. He is able to distinguish between the signifier and the actual object but his thought is still not reflective. He is too realistic in that he judges events on their face value. Rather than consider two or more features of an object, he conceptualizes on only single salient features. He reveals tranductivity of thought by relating the particular to the particular (if A is like B in one respect, then A must be like B in all respects).

The intuitive period

From four to seven years the child increases his symbolic functioning but his "egocentric" thinking still dominates his perceptions. Three fundamental functions appear during this period: the ability to think in terms of classes, to see relationships, and to handle number concepts. The child can now classify on the basis of similarity but he still only considers one characteristic of the stimuli.

The concrete operational period

During the years from seven to eleven the child indicates that he is capable of logic. He reveals increasing objectivity by freeing himself from the domination of his perceptions that characterized his previous thought. He is able to perform logical operations in simple arithmetic (reversibility), organize objects into hierarchies (classification), arrange items along a continuum (seriation), and realize certain properties are invariant when they appear to change (conservation).

The formal operational period

The child in his final developmental period from eleven to fifteen years becomes truly logical. He can finally ignore content and operate on hypothetical procedures of thought by creating hypotheses and deducing

conclusions. Scientific investigations are now possible because he can deal with all kinds of combinations in a systematic order where before he could only deal with one variable at a time.

Concept Formation Behavior of the Mentally Retarded

The Object Sorting Test, Color-Form Test, and the Similarities Tests have been used as experimental tasks in studies of concept formation in the mentally retarded by Silverstein and Mohan (1962, 1963), Iscoe and Geller (1959), Hughes (1960), Stacey and Chalmers (1951), Korstvedt et al. (1954), Halpen and Patterson (1954), and Stacey and Markin (1951). Rapaport et al. (1944) provides a description of the Object Sorting and Color-Form tests:

> The Color-Form Test consists of twelve pieces of cardboard of four different colors and three shapes. The subject is first asked to "put together all those that belong together." After he has made his first sorting either on the basis of color or form he is asked to put them together in another way, a different way. Success is measured by the ability to shift from one category to the other, failure by repetition of the first category, or by the construction of patterns or mixed groups. After the subject has completed his grouping he is asked to tell why the objects belong together. Subjects are scored as able to make two, one, or no groupings.
>
> The Object Sorting Test consists of thirty-three objects such as real and toy tools, silverware, a ball, bicycle bell, etc. In the first part of the test, the subject is handed seven objects, one at a time, and told to put with each all that belongs with it. After he has completed his groupings, he is asked to tell why they belong together. In the second part of the test the subject is presented with twelve groupings, which he is asked to define. These groupings are based on use, color, form, material, or the existence of pairs. (Rapaport et al., 1944, p. 156)

The Similarities tests from the Wechsler intelligence Tests presents pairs of words to the subject who is asked to tell how they are alike.

Silverstein and Mohan (1963) and Iscoe and Geller (1959) used the following criteria for scoring responses of institutionalized retardates

in their studies:

1. Publicness--commonly used attributes were used in sorting.
2. Privateness--uncommonly used attributes were used in sorting.
3. Open--a single attribute was used in sorting.
4. Closed--all attributes were used in sorting.

Silverstein and Mohan (1963) tested their retardates with the Object Sorting, Color-Form, and Similarities tests and found: in general, the subjects fell into the closed-private area which was significantly related to their hospitalization and indicative of concrete behavior; the less retarded had more concepts based on a single common attribute (open-public) and with increasing age all subjects indicated this. The less retarded had more concepts based on principles freely communicated in our society. Iscoe and Geller (1959), like Silverstein and Mohan (1963), reported that all retarded groups sorted on a "closed" system and that sex differences in performance on the Object Sorting Test were not significant.

Silverstein and Mohan (1962) used only the Color-Form Test in a second study with institutionalized retardates and reported the following: 40 to 70 percent of retardates build patterns; pattern building, the use of color or form, and whether subjects could account verbally for their sortings, were not significantly affected by age, sex, IQ, diagnosis, or length of hospitalization.

Hughes (1960) reported differences in superior, average, and retarded groups matched on mental age by comparing them on the Color-Form, Object Sorting and Similarities tests:

> The hypothesis that the three groups in the order of superior, average, and mentally retarded would differ in conceptualizing ability was substantiated. The superior subjects were significantly higher on the verbal part of the Color-Form Test and

exhibited a trend in this direction on the sorting tests. (Hughes, 1960, p. 3379)

Stacey and Chalmers (1951) compared mildly retarded and borderline retarded adolescents matched on chronological age with the Object Sorting Test. They discovered no significant differences in the sortings or the verbalizations of the sortings but the borderline subjects had more "functional" and adequate "abstract" responses than the retarded.

Korstevdt et al. (1954) found differences between borderline, average, and mildly retarded adolescents on the Color-Form Test. The average group was significantly more successful than the borderline and mildly retarded groups.

Halpin and Patterson (1954) used the Color-Form Test and the Cube Test to compare familial and brain injured retarded groups with a mean mental age of 5.8. They indicated the following: On the Color-Form Test, only one-third of each group shifted from one sorting to another and none of the subjects learned to shift during the induced shifting task; on the Cube Test the familial group did significantly better than the brain injured in sorting.

Stacey and Markin (1951) compared dull normal, borderline retarded, and mildly retarded matched on chronological age with the Similarities test of the Wechsler Intelligence Scale, Form I. They reported that dull normals had significantly more "descriptive" responses and that retarded had the greatest number of "functional" responses but in "abstract" responses no significant differences existed.

Hoffman (1955) studied mildly retarded, average and superior adolescents on their ability to conceptualize the following dimensions:

1. Size--large versus small designs

2. Regularity--symmetrical versus asymmetrical designs

3. Depth--two dimensions versus three dimensions

4. Acuteness--round versus pointed shapes

5. Thickness--thick versus thin

6. Solidity--solid or blocked in, versus contour designs

He concluded from his results that: the concept of regularity was the most difficult to grasp and solidity the easiest; a positive relationship existed between IQ and depth perception; and conceptual scores correlated highest with Wechsler Verbal IQ's, particularly the conceptual scores of the retarded.

Clark and Thompson (1964) used two series of cards with mildly retarded and normals to study classification behavior. Series I required classification of common objects and Series II classification of social concepts. They found that: classification of social concepts was not so closely related to IQ as classification of common objects; the youngest and dullest children were unable to classify at all; only 7.9 percent of retardates approached the performance of the normals; and no significant sex differences existed.

Zaslow (1961) developed a task consisting of fourteen designs, each printed on a separate card, that formed a continuum from triangularity to circularity. He tested children from grades two and three, junior high school students, high school students, mildly retarded, and paretics on their ability to organize the designs into a continuum. Zaslow concluded that children from grades two and three, retardates and paretics indicated conceptual inferiorities by constricting the concept span (concrete behavior), pairing cards, sorting on the basis of chance, pairing cards, sorting on the basis of chance, pairing opposites and

failing to improve their conceptualizing performance from increased cues. He indicated that retardates exhibited "intolerance for ambiguity" by dividing the continuum into parts.

Number and Space Concepts of the Mentally Retarded

Woodward (1961, 1962) investigated number and spatial concepts of mildly and severely retarded adults and children. Her four experiments for number concepts, which were used by Piaget with normal children, are described below:

Experiment I: One to one correspondence of equivalent sets--subjects were required to pair a row of ten and a circle of twelve counters.

Experiment II: Equalizing unequal groups--subjects were required to make equal in number two unequal groups of counters.

Experiment III: Seriation--subjects were required to put in order ten sticks different in size and then required to insert a second set of sticks.

Experiment IV: Conservation--subjects were questioned about the equality of water after the contents of a glass were poured into a tall glass which held the same volume as the first glass but was different in shape.

Woodward (1961) reported that her retarded subjects performed at the concrete operational level or intuitive level in all four experiments. Her subjects reached a relatively advanced level with problems involving a 1-1 correspondence between two sets of objects. An understanding of problems involving series and part-whole relations develops later. She indicated a trend in median IQ's to increase concrete

operational thinking but these results were not statistically significant.

Woodward (1962) used the following three experiments, which were devised by Piaget and Inhelder, to investigate spatial concepts in mildly and severely retarded:

> Experiment I: Linear and Circular Order--tested the child's ability to copy a spatial order by placing beads in the same order as those of a model shown to him.
>
> Experiment II: Drawing--tested the child's ability to copy 21 figures.
>
> Experiment III: Reference Points--tested the child's ability to use external reference points to indicate the level of water in a vessel.

Two hypotheses of Woodward were confirmed by the study. The first hypothesis concerned the types of spatial thinking that would be found in retardates when compared to normals:

> The first hypothesis has been confirmed for both concepts of number and space: the same types of responses have been found among sub-normal subjects as Piaget and Inhelder report from their studies of normal children aged four to seven. (Woodward, 1962, p. 35)

A second hypothesis comparing the sequence of stages of spatial concepts in retardates and normals was also substantiated:

> The sequence suggested by Piaget and Inhelder was confirmed for all three spatial concepts investigated. For the spatial order tasks, the order of difficulty for subnormal subjects was found to be the same as that claimed by Piaget and Inhelder to develop at successive stages in normal children. (Woodward, 1962, p. 35)

A third hypothesis, that retarded subjects would show the same type of thinking for all spatial concepts was not completely substantiated. In Experiment II some subjects failed to reproduce figures correctly

which Piaget and Inhelder claimed to be of comparable difficulty to figures they did copy correctly. Woodward (1962) offers the following explanation for their uneven performance:

> Two characteristics of the severely subnormal might account for findings on drawing: one is the limited intellectual development of the subjects, and the other is the high incidence of cerebral abnormality in the group investigated. (Woodward, 1962, p. 36)

Summary

This section presented a review of research literature conducted with the mentally retarded from years 1904 to 1965. McPherson (1947) considered the few studies conducted before 1947 as lacking in sound scientific procedures and information. Since 1950 more and better information about the learning characteristics of the retarded has become available through increased research activity. Woodrow's (1946) warning that abilities can only be defined in terms of the task accomplished was considered a necessary statement for application of the research findings.

In general, studies on perceptual abilities, verbal mediation, paired associate learning, object discrimination learning, delayed reaction learning, transfer of training and stimulus generalization and concept formation indicate statistically significant relationships between performance by retardates on the experimental tasks and mental age and/or IQ. Psychometric data indicate distinct differences between abilities of the retarded and the intellectually normal.

The conflicting results of studies comparing retardates and normals on perceptual abilities and the effects of reinforcement and incentives should be interpreted in the light of Woodrow's (1946) statement

concerning the consideration of the requirements of the experimental tasks.

Theories of low satiation on figure-ground relationships, a desire for social approval, chronological age and the existence of retardation were presented as explanations for "rigidity" in the retarded.

A summary statement of Piaget's stages of cognitive development was included. The development of number and space concepts of the retarded were reported to closely parallel those of intellectually normal individuals.

RESEARCH DESIGN

The Relation of This Design to Previous Studies

Concept formation experiments fall into two types, modified memory and sorting tasks. On modified memory experiments subjects "unconsciously" evolve the concept while solving what they think is a memory problem; on sorting experiments subjects are required to sort objects according to their attributes.

Stone's (1965) investigation extended sorting experiments to three dimensions. This approach required subjects to solve a pre-cued problem by sorting 54 objectshorizontally and vertically in hierarchic order in a 3 x 3 x 6 matrix set up in tray form. His objects varied in color, form, and size. By preplacing two objects in his three dimensional matrix, Stone developed a problem with only one correct solution. To attain this correct solution, the "logic" of the subjects had to over-ride any "concrete" orientations. In this sense the solution of the problem was a direct test of Piaget's "formal operational" stage of intellectual development.

To study the effects of standardized discrimination training on his experimental task, Stone gave 20 percent of his subjects additional directions for increasing discrimination of his task objects.

The present study resembles Ston's experiment in several respects. A reduced matrix of 3 x 3 x 3 set up as trays was used with 27 objects of varying color shades, forms and sizes. The effects of discrimination training were studied with one-third of the subjects. The studies differ basically in two respects. Stone used intellectually normal school

children in grades one through nine and an adult group while the present study used about one-half intellectually normal school children and one-half mildly retarded adolescents and adults. The present study did not have a "correct solution" so the one cue used only provided a reference point, while Stone's cues provided a basis for a complete solution.

Subjects

The 207 subjects of this study included five groups of intellectually normal children, two groups of mildly retarded adolescents and two groups of mildly retarded adults.

The intellectually normal children were attending grade three in Cache County School District, Cache County, Utah, and grade six in Logan City School District, Logan, Utah. The retarded subjects consisted of adolescents attending special classes in the Ogden City School District, Ogden, Utah, and non-institutionalized adults employed by "Laradon," a sheltered workshop in Denver, Colorado. The neighborhood schools attended by the intellectually normal children and the retarded adolescents were approximately equal in socio-economic level.

As shown in Table 1, one-third of the subjects from each group received additional training designed to increase discrimination of the task objects. Subjects were not matched on sex in either regular or discrimination treatments, because several other concept studies with similar tasks have found no significant differences in performance of males and females.

The selection of the intellectually normal children from grades three and six was based on their composite verbal-performance IQ scores from the California Test of Mental Maturity (CTMM). This test had been

administered by their schools within the last two years. The IQ ranges for grouping the subjects at IQ levels were determined by consulting the CTMM Manual.

Table 1. Number of subjects by grade

Group	Grade	IQ level	Treatment		Total
			Regular	Discrimination	
1	3	High average	14	7	21
2	3	Low average	14	7	21
3	6	Superior	14	7	21
4	6	High average	14	7	21
5	6	Low average	14	7	21
6	Special classes (Adolescents)	High mildly retarded	20	10	30
7	Special classes (Adolescents)	Low mildly retarded	20	10	30
8	Adult	High mildly retarded	14	7	21
9	Adult	Low mildly retarded	14	7	21
Total			138	69	N = 207

The selection criteria for the retarded adolescents and adults were similar. All subjects were required to have IQ's within the mildly retarded range of 50-75 and to be free from any medical and/or psychological history of central nervous system damage. The required chronological age range for adolescents was 13.0-18.5, and for the adults 20.0-35.0. Only adolescents enrolled in special classes of public schools and non-institutionalized adults residing in urban communities qualified for the

study.

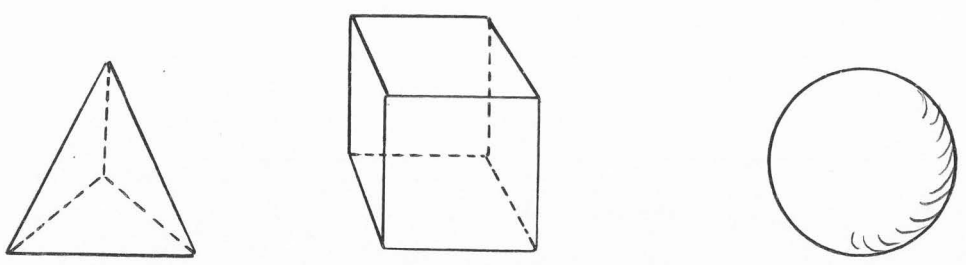
The 60 adolescent and 42 adult retarded subjects were arbitrarily divided into high and low groups of equal number on the basis of IQ. As illustrated in Table 1, this procedure grouped the upper IQ half into the high IQ level and the lower IQ half into the low IQ level. The IQ ranges of the high IQ levels were much narrower than the low IQ levels because most of the retarded adolescents and adults were within the 70-75 range.

Methods and Procedures

Material and task

The standardized procedure for the administration of the experimental task consisted of three parts for 138 of the 207 subjects in the study.

Each subject was first asked to look into a container box that held 27 objects. The objects were of three kinds: sphere, cube, and tetrahedron; three sizes: 1-1/2, 1, and 3/4 inches; and three shades of blue: dark, medium, and light. Figure 1 illustrates the forms.



Tetrahedron (4 sides) | Cube (6 sides) | Sphere (Infinite)

Figure 1. The three stimulus objects of the experimental task.

Second, the subject was asked to look at three movable trays near the object container box. The trays were moved back and forth to demonstrate their accessibility. The trays were made of clear plastic and were placed 1/16 inch apart so that the subject could see through them from both horizontal and vertical angles. This is illustrated in Figure 2.

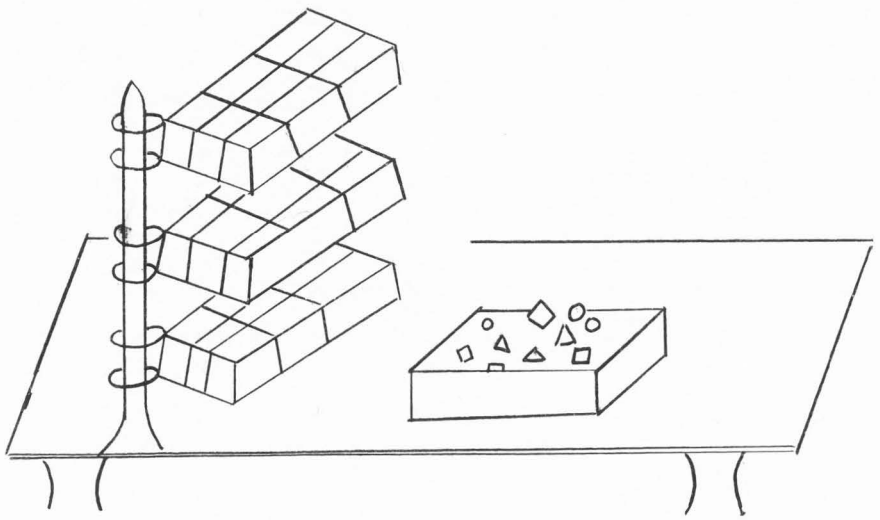


Figure 2. The movable sorting trays, 3 x 3 x 3 = 9 compartments per tray and the container box.

Third, the subject was given the following explicit directions for completing the task:

> "Look carefully at the objects in the large container box. Now look at the movable trays. Notice the small boxes in each tray. In a moment you are to put one object in each of the small boxes in the trays, one in each, so that when you are through, all the objects will be gone from the container box, and will be in the trays. Try to put them in so that if you were asked to remember where each one was, you could find them with your eyes closed.

> Put them in any tray you care to. There is already one object in the trays. Can you see it? (experimenter points) It should not be moved. Begin when you are ready."

The directions were designed to provide the subject with the apparent freedom to place the 26 objects in the trays according to his own personal desires. With a small number of subjects, an additional instruction to place the objects adjacent to some other object already in the trays was necessary. This prevented haphazard skipping of boxes which would have greatly reduced the possibility of the subject developing some structure to his sortings.

For 69 of the 207 subjects in the study, the following additional directions were added as discrimination training:

> "In the container box, how many kinds of objects do you see? (pause) Place one of each kind on the table in front of the box. (Time was allowed until the subject had one of each) All right, how many kinds are there? (pause) All right, three is correct. Now, how many sizes do you see? Find one of each. (pause) Yes, there are three; large, medium, and small. Now, how many colors are there? Find one of each. Yes, there are three colors; dark blue, medium blue and light blue."

Although the subjects were not required to complete the task within a time limit, they usually finished within five minutes after receiving the directions.

The cue

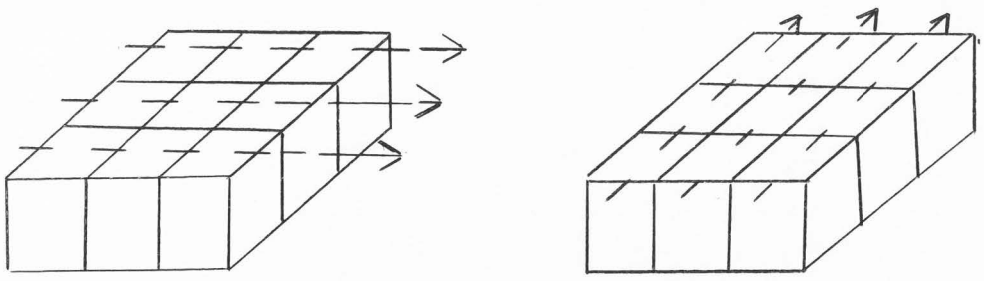
One of the task objects was pre-placed by the experimenter in the center box of the middle tray. This medium sized, medium blue cube provided a reference point for the subject's sortings if he chose to use it; but because the experimental task was not conceived as a "problem" requiring certain correct solutions, the subject could ignore the cue and still gain high scores on his sortings.

Scoring

Top-oriented color, form, and size identities. Top-oriented identity

scores were based on pairing and grouping the task objects. In color identities, the subject was given credit for pairing and grouping objects. In color identities, the subject was given credit for pairing and grouping objects of the same color; in form identity, objects of the same form; and in size identities, objects of the same size. Each tray was scored separately by determining the identity points for left to right and front to back lines.

Figure 3 illustrates the directional procedures followed in scoring left to right and front to back identities and progressions. The total left to right top-oriented color identity score, as an example, was determined by adding the left to right color identity scores for all three trays; for front to back color identities, the total score was determined by adding the front to back color scores for all trays. The same procedures were followed in determining total form and size identity scores. Top-oriented progressions were scored by following the same directional procedures as in Figure 3, but different scoring formulas were used. These will be discussed in a following section.



Left to right Front to back

Figure 3. The directional procedures followed in scoring left to right and front to back identities and progressions for color, form, and size.

The following formulas were used as a basis for scoring all combinations of color, form, and size identities:

1. Two objects of the same color shade, same form, or same size paired in one line = 1 pt.
2. Three objects of the same color shade, same form, or same size grouped in one line = 3 pts.
3. Four objects of the same color shade, same form, or same size grouped as a block = 4 pts.
4. Six objects of the same color shade, same form, or same size grouped as a block = 6 pts.

The scoring of top-oriented left to right and front to back color, form, and size identities resulted in six identity scores.

Scoring reliability was established by carefully working out and recording the scoring formulas on a master scoring chart. This provided objective scoring without the necessity of subjective judgement.

The formulas for blocking groups of 4 and 6 identities were established arbitrarily on the basis of increased credit for increased complexity.

The highest possible identity score for a tray was 18, 1 point for each box running left to right and 1 point for each box running front to back. This is illustrated below in Figure 4 with color but it also applied to form identity scores when the objects of a tray were all of one form, and to size identity scores when the objects of a tray were all of one size.

To provide a base for comparing top-oriented identity scoring, a standard tray of stimulus objects was use. This is illustrated in Figures 5, 6, and 7. These figures illustrate the color, form, and size identity scoring formulas.

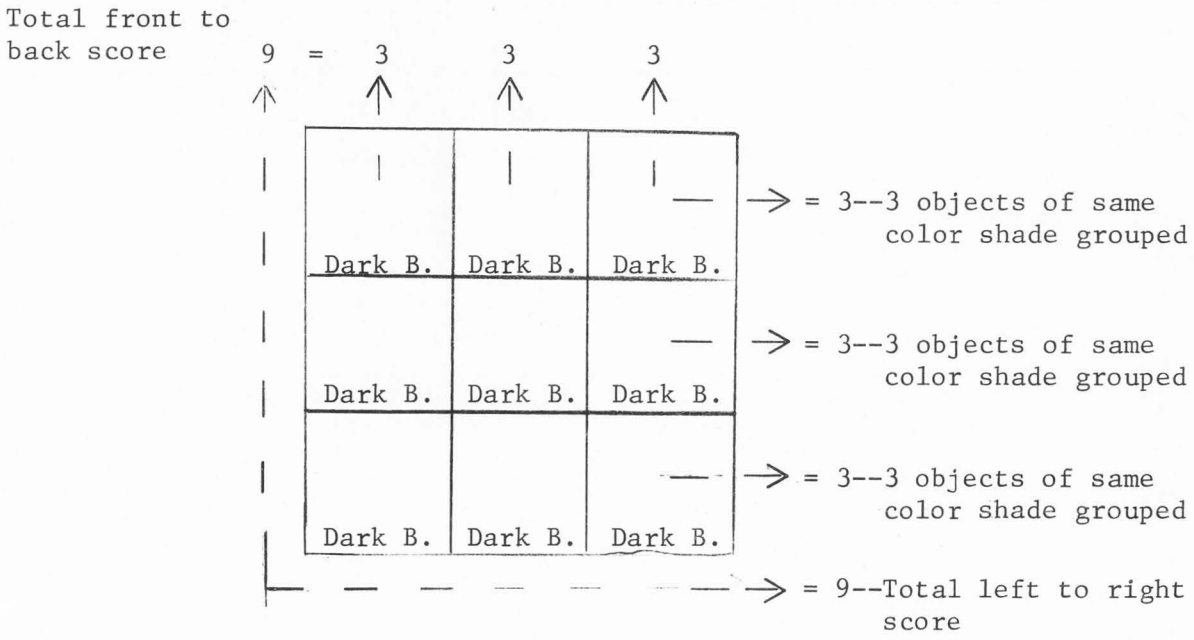


Figure 4. Diagram showing the highest possible color identity score for one tray.

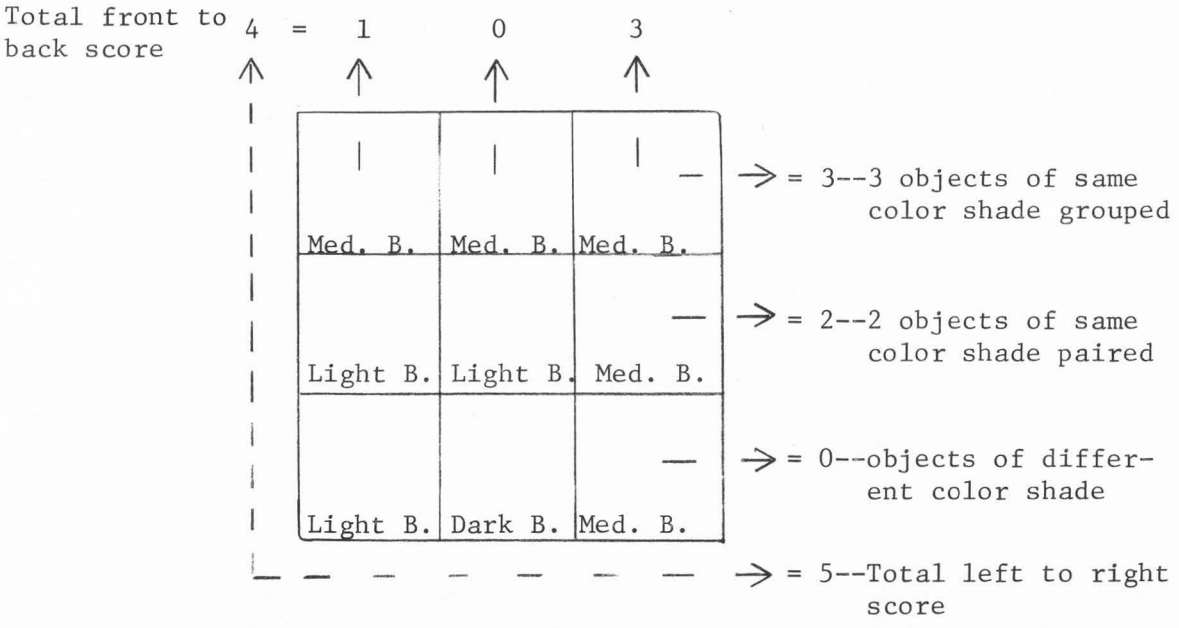


Figure 5. Diagram showing top-oriented scoring of a single tray for color identities.

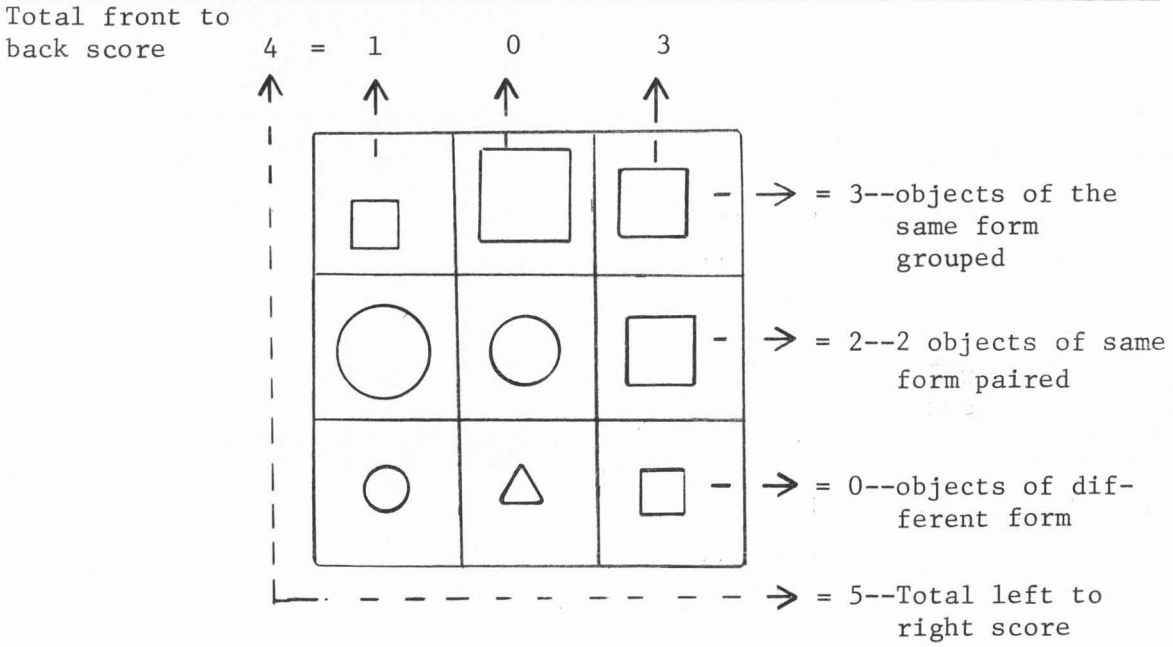


Figure 6. Diagram showing top-oriented scoring of a single tray for form identities.

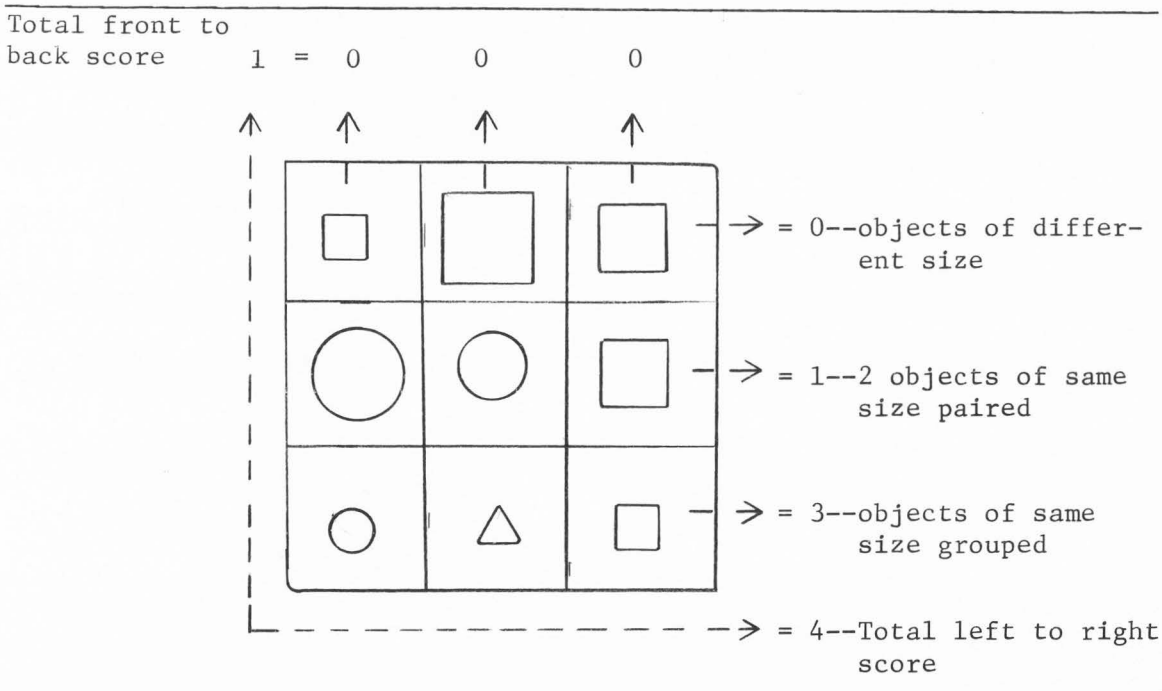


Figure 7. Top-oriented scoring of a single tray for size identities.

The scoring of a group of four color identities as a block without the standard tray is illustrated in Figure 8.

The standard tray used in Figures 5, 6, and 7 has been altered in Figures 8 and 9. This was necessary to accomodate illustrations of grouping color identities in blocks of four and six. The formula for scoring groups of 4 and 6 identities as a block awarded 1 point for each object in the block rather than 1 point for each pair of objects, as in a line. This arbitrary decision was based on the logic that blocks of 4 and 6 identities constituted higher levels of grouping than pairings of 2 and groupings of 3 in a line.

The scoring of a group of six color identities in a block is illustrated in Figure 9.

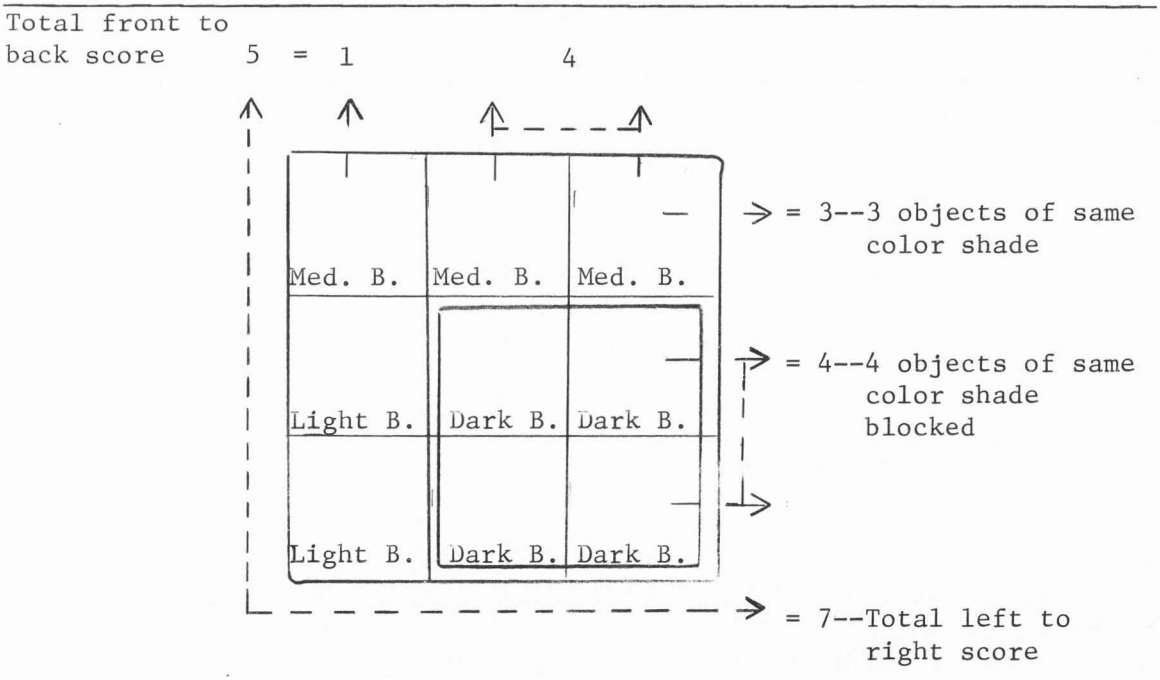


Figure 8. Scoring of a single tray for a group of four color identities in a block.

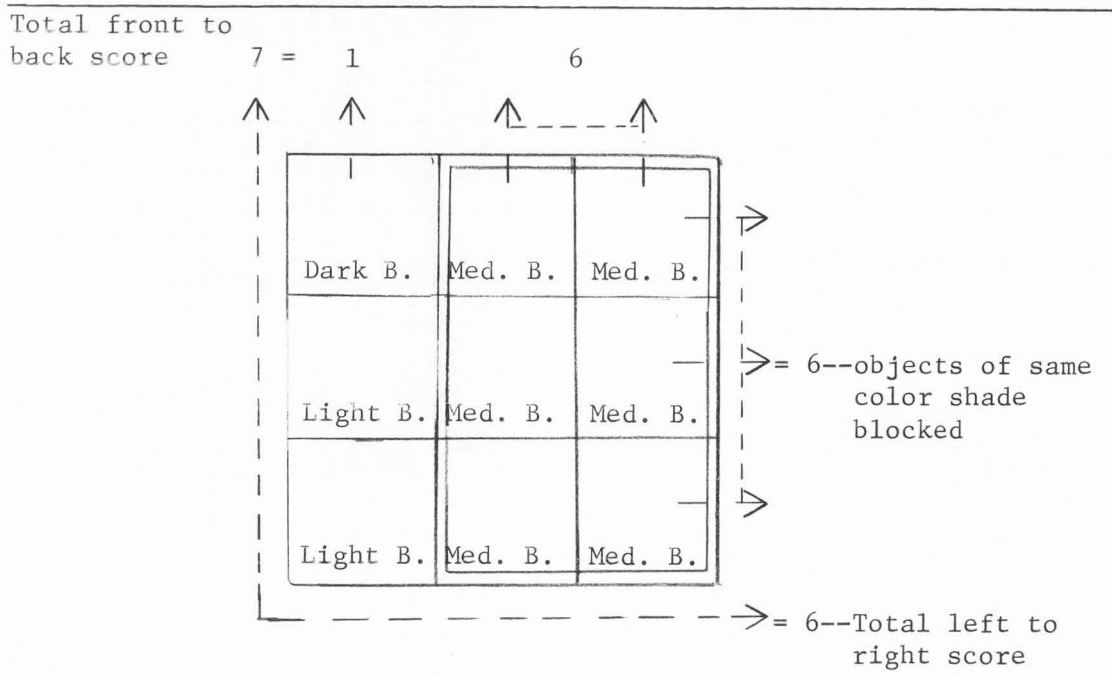


Figure 9. Scoring of a single tray for a group of six color identities in a block.

Top-oriented color, form, and size progressions

While top-oriented identity scores were based on pairing and grouping objects of the same color, form and size, top-oriented progressions were based on changing the color, form, and size of pairs and groups. As with identities, each tray was considered separately by scoring left to right and front to back lines. No bonus credit was awarded for blocking. Although the formulas for scoring color, form, and size progressions are very similar, they will be considered individually for added clarity. Color progressions are explained below:

1. A change involving two different shades of blue in one line = 1 pt.

2. A change involving three different shades of blue in one line but an imperfect progression = 2 pts.

3. A change involving three different shades of blue in one line in perfect progression (either dark, medium, light or light, medium, dark) = 3 pts.

The highest possible score for a tray of progressions was 14; 7 for left to right, and 7 for front to back. This maximum score also applied to trays scored for form and size progressions. This is illustrated for color in Figure 10.

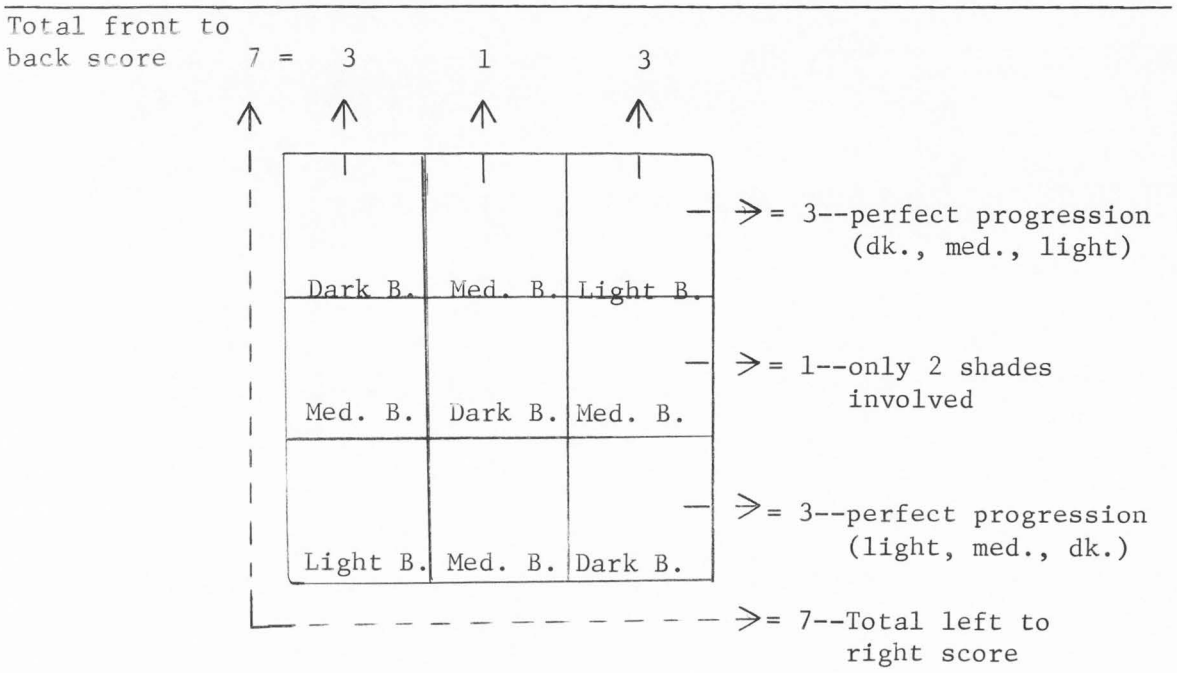


Figure 10. Top-oriented scoring of a single tray for highest possible color progressions score.

A standard tray of objects is also used in this section to illustrate formulas for scoring top-oriented color, form, and size progressions. In Figure 11 the standard tray is scored for color progressions.

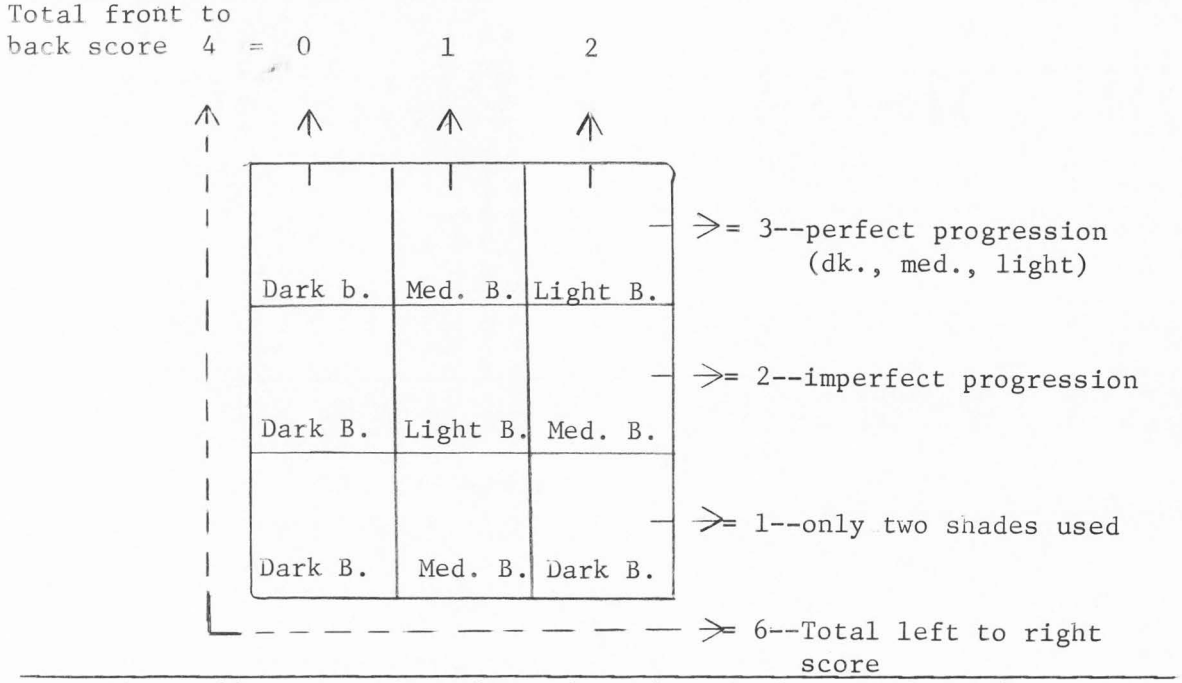


Figure 11. Top-oriented scoring of a single tray for color progressions.

The formulas for scoring top-oriented <u>form progressions</u> are explained below:

1. A change involving two different forms in one line = 1 pt.
2. A change involving three different forms in one line but an imperfect progression = 2 pts.
3. A change involving three different forms in one line in perfect progression (the cube and the tetrahedron must be in adjacent boxes in a line) = 3 pts.

The formulas for scoring top-oriented <u>size</u> progressions are explained below:

1. A change involving two different sizes in one line = 1 pt.
2. A change involving three different sizes in one line but an imperfect progression = 2 pts.
3. A change involving three different sizes in one line in perfect progression (large, medium, small or small, medium, large = 3 pts.

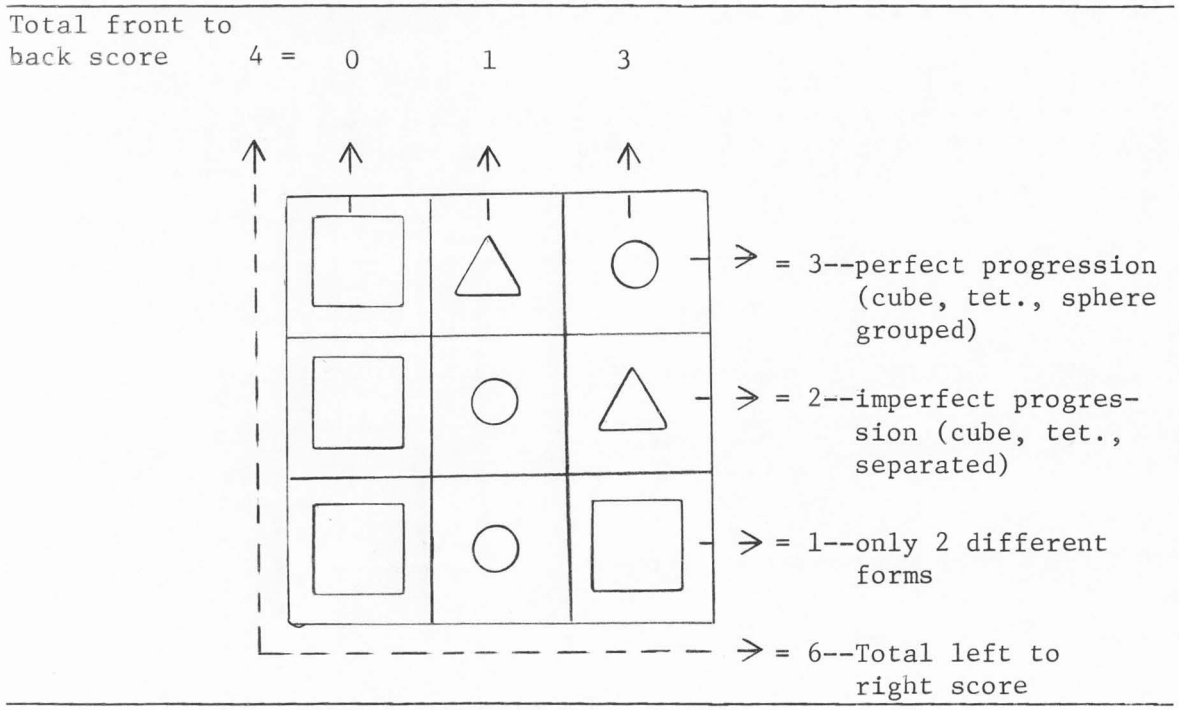


Figure 12. Top-oriented scoring of a single tray for form progressions.

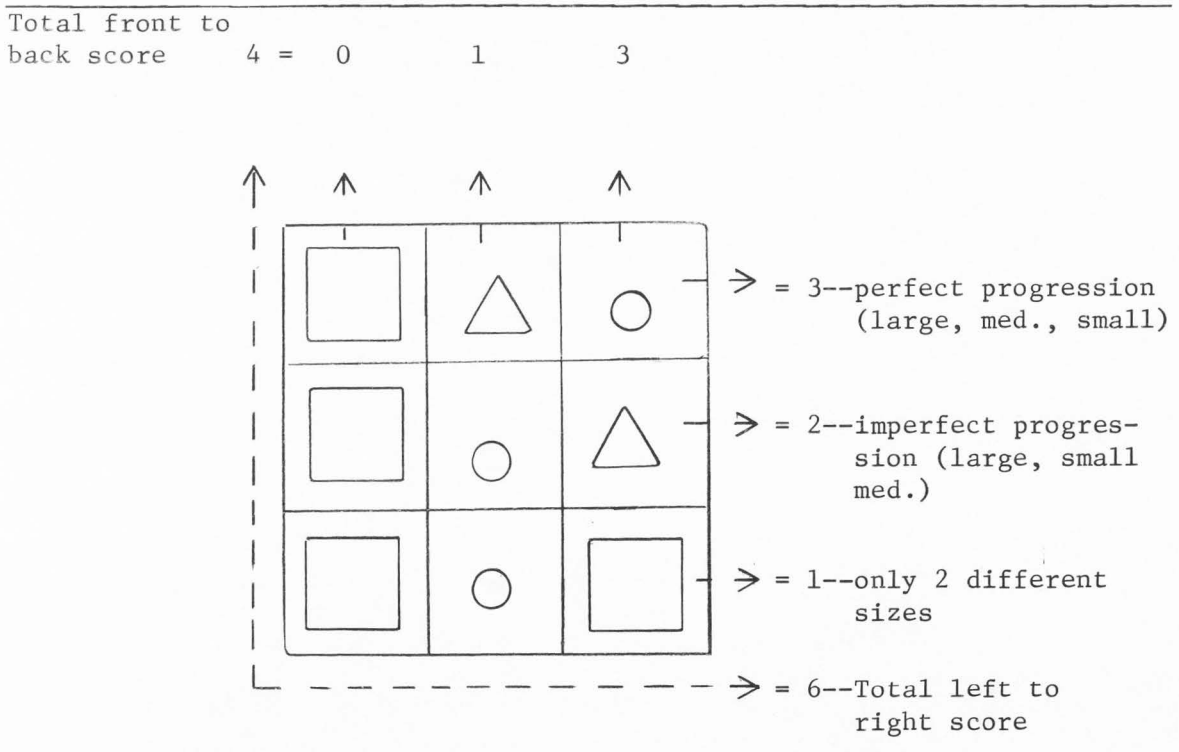


Figure 13. Top-oriented scoring of a single tray for size progressions.

The scoring of top-oriented left to right and front to back color, form, and size progressions resulted in six progression scores. This added to the six identity scores totaled 12 top-oriented scores for each subject.

Front-oriented color, form, and size identities

While top-oriented scores indicated horizontal pairing and grouping of identities and progressions within each individual tray, front-oriented scores indicated vertical pairing and grouping of identities and progressions among the three trays. The directional procedures followed for left to right and front to back front-oriented scoring are illustrated in Figure 14.

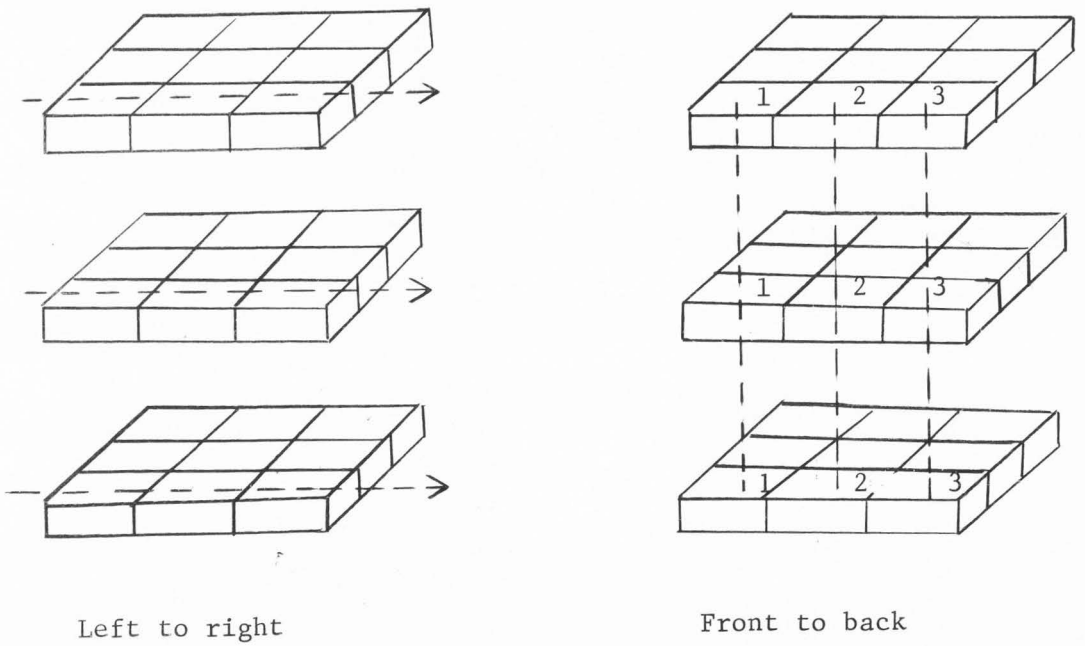


Figure 14. The directional procedures followed for left to right and front to back front-oriented scoring of identities and progressions, for front face.

To facilitate front-oriented scoring, each subject's sortings were recorded on a scoring sheet that had diagrams of three trays. The color, form, and size of his objects were recorded in the diagram boxes that corresponded to the actual trays. To accurately score each subject's sortings, a template was placed over the scoring sheet so that the same line of each tray was isolated. For example, to score left to right identities for line 1, the template was placed over all three trays so that only line 1 of each tray could be seen. To score line 2, the template was moved upward to reveal only line 2 of each tray, and to score line 3, the template was moved upward again. The same procedure was followed with the template in front to back identity scoring except the points were determined by running from front to back through all three trays.

Left to right color identity scores were determined by placing the template on the scoring sheet and scoring line 1 of the bottom tray from left to right, then line 1 of the middle tray and then line 1 of the top tray. The three line 1 scores were then added for the total left to right color identity score for line 1. The same procedure was followed in obtaining total scores for line 2 and line 3. To obtain the final total front-oriented left to right color identity score for a subject, the totals for all three lines were added. The same procedure was also followed in scoring left to right form and size identities.

The front to back color identities score was determined in a similar manner except for the directional procedure. Here box 1 of the bottom tray, middle tray, and top tray were scored as a line in a vertical direction, then box 2 of all three trays, and finally box 3 of all three trays. The scores for boxes 1, boxes 2, and boxes 3 were added to obtain a total

score for line 1. The same procedure was used for line 2 with boxes 4, 5, and 6 running across all three trays, and in line 3 with toxes 7, 8, and 9. The same procedure was followed in scoring front to back form and size identities. To illustrate the scoring of front-oriented left to right and front to back color identities a replication of the scoring sheet without the template is shown in Figure 15.

The front-oriented left to right color identity scores for Figure 15 are shown below:

1. Line 1--bottom tray = 3; middle tray = 3; top tray = 3 (all light blue) Total = 9 pts.

2. Line 2--bottom tray = 3; middle tray = 3; top tray = 3 (all medium blue) Total = 9 pts.

3. Line 3--bottom tray = 3; middle tray = 3; top tray = 3 (all dark blue) Total = 9 pts.

Total left to right identity score = 27 pts.

The total front-oriented front to back color identities for Figure 15 are scored below:

1. Line 1--boxes 1 in all three trays = 3; box 2 in all three trays = 3; box 3 in all three trays = 3 (all light blue) Total = 9 pts.

2. Line 2--box 4 in all three trays = 3; box 5 in all three trays = 3; box 6 in all three trays = 3 (all medium blue) Total = 9 pts.

3. Line 3--box 7 in all three trays = 3; box 8 in all three trays = 3; box 9 in all three trays = 3 (all dark blue) Total = 9 pts.

Total left to right identity score = 27 pts.

Front-oriented color, form, and size progressions

The same scoring formulas used for top-oriented progressions, and the same template and procedures used in scoring front-oriented identities, were used in scoring front-oriented progressions.

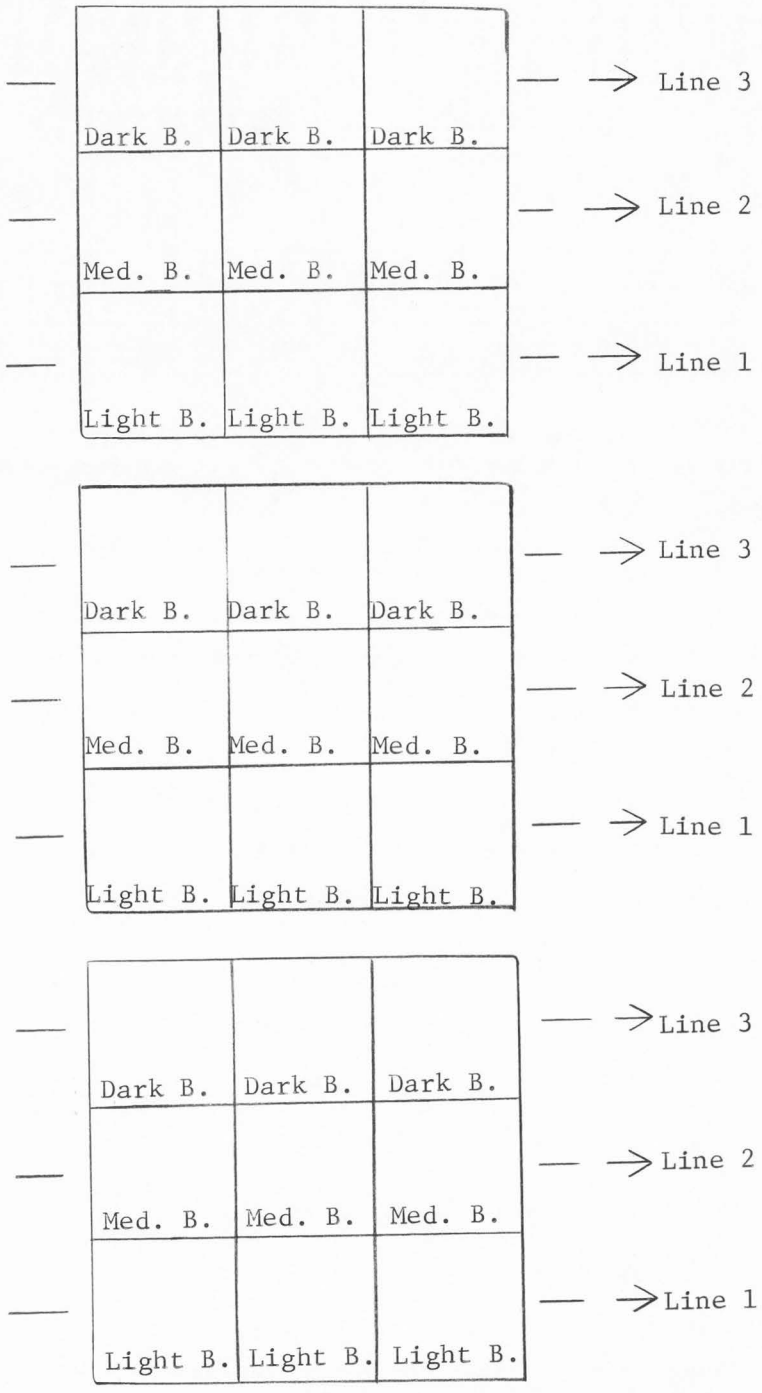


Figure 15. The scoring of front-oriented left to right and front to back color identities using a replication of the scoring sheet.

If the trays used in illustrating front-oriented color identity scoring in Figure 15 were scored for front-oriented color progressions, the following scores would occur:

1. Left to right color progressions--line 1 in all three trays = 0; line 2 in all three trays = 0; line 3 in all three trays = 0 (no changes in color in all three lines) Total = 0 pts.

2. Front to back color progressions--line 1 with boxes 1, 2, and 3 in all three trays = 0; line 2 with boxes 4, 5, and 6 of all three trays = 0; line 3 with boxes 7, 8, and 9 in all three trays = 0 (no color changes in all three lines) Total = 0 pts.

The scoring of front-oriented left to right and front to back color, form, and size progressions resulted in six progression scores. This added to the six identity scores totaled 12 top-oriented scores. The total top-oriented and front-oriented identities and progressions for color, form, and size plus the top-bottom ratio score described in the next section equaled 25 scores for each subject.

Top-bottom tray ratio of the large objects

The top-bottom tray ratio indicated whether the subjects tended to use "concrete" or more logical approaches in their sortings. If they sorted the larger, easier to pick up, objects into the top tray, "concrete" thinking tended to dominate; but if they sorted these objects into the bottom tray, more logical thinking was evident. This ratio weighed the concrete-formal operational stage theory of Piaget.

Statement of Objectives

The two objectives of this study are:

1. To compare intellectually normal children, mentally retarded adolescents and mentally retarded adults on a three dimensional

classification task.

2. To determine the effects of discrimination training on the performance of intellectually normal children, mentally retarded adolescents, and mentally retarded adults on a three dimensional classification task.

Definitions of Terms

Concept formation. This term refers to the individual by unique organization of the task objects by each subject on the bases of color shade, form, and size. The subjects indicated their organization by their arrangements of the task objects in the three trays.

Structure. This term refers to a plan or system used by the subjects of this study in placing the task objects in the three trays.

Regular subjects. This term refers to the subjects of this study who did not receive special orientation training before they placed the task objects into the three trays.

Discrimination subjects. This term refers to the subjects of this study who did receive special orientation training designed to increase their discrimination of the task objects before they placed the task objects into the three trays.

Intellectually normal groups. This term refers to the following IQ groups: high average grade 3 (IQ = 111.0); low average grade 3 (IQ = 96.6); superior grade 6 (IQ= 128.0); high average grade 6 (IQ = 111.4); and low average grade 6 (IQ = 95.6).

Mentally retarded groups. This term refers to the following IQ groups: high adolescent retardates (IQ = 73.3); low adolescent retardates (IQ = 64.9); high adult retardates (IQ 71.7) and low adult

retardates (IQ = 61.5). Both regular and discrimination subjects of each group were highly comparable in IQ.

Identities. This term refers to the pairing and grouping of the task objects on the bases of identical color shades, identical forms and/or identical sizes in three trays by the subjects of this study.

Progressions. This term refers to the organization of the task objects on the bases of different color shades, different forms and different sizes in three trays by the subjects of this study.

Top-oriented. This term refers to the organization of the task objects horizontally in the three trays by the subjects of this study.

Front-oriented. This term refers to the organization of the task objects vertically in the trays by the subjects of this study.

Limitations of the Study

1. This study was limited in that only subjects in the following groups were included: intellectually normal third and sixth grade children from Cache County School District, Cache County, Utah and Logan School District, Logan, Utah; mildly retarded adolescents attending special classes in the Ogden City School District, Ogden, Utah; and non-institutionalized adults employed by "Laradon," a sheltered workshop in Denver, Colorado.

2. The subjects' sortings of the task objects were scored on the basis of top-oriented and front-oriented color, form, and size identities and progressions.

Source of Data

The data for this study was collected by the writer by individually

administering the experimental task to all subjects. The IQ scores of the subjects were obtained from their personal records kept by the institutions they were attending.

Data Analysis

After this writer personally scored each subject's responses, the data was processed on an IBM computer. The results are reported in the following section.

ANALYSIS OF DATA AND FINDINGS

Objectives

The objectives of this study were (1) to compare nine groups of subjects composed of intellectually normal children, mentally retarded adolescents, and mentally retarded adults on a three dimensional classification task, and (2) to determine the effects of discrimination training on the performance of the nine groups of subjects on the three dimensional classification task. A randomized analysis of variance was used to test for significant differences in scores comparing the nine groups and also for each of the nine groups separately. A 1620 IBM computer was utilized for these analyses.

The Chronological Age and IQ Levels for the Nine Groups

The chronological age and IQ levels for the nine groups were also part of the IBM analysis of the experimental data.

The chronological age differences between the regular and discrimination subjects in each of the nine groups were slight. Only groups 8 and 9 with 14 month and 11 month differences respectively exceeded a 6 month difference. The larger differences in the latter two groups were the result of the heterogeneous chronological ages of the mentally retarded adults who worked in Laradon, a sheltered workshop. These groups had a chronological age range from 20-35 years. The regular and discrimination subjects within each group was comparable in chronological age, as seen in Table 2.

With the exception of group 3, the IQ levels of the regular and

discrimination subjects in each group were also comparable. These chronological ages and IQ levels for the regular and discrimination groups are included in Table 2.

Table 2. Chronological age and IQ levels for regular and discrimination groups

Group	Grade	Chronological age		IQ level	
		Regular	Discrimination	Regular	Discrimination
1	3 high average	9.0	9.0	111.0	111.0
2	3 low average	9.1	9.1	96.6	97.0
3	6 superior	12.0	11.8	128.0	136.1
4	6 high average	12.0	12.1	111.4	112.1
5	6 low average	12.1	11.9	95.6	92.6
6	Special class adolescents, MR	14.6	14.7	73.3	73.6
7	Special class adolescents, MR	15.7	15.1	64.9	65.5
8	Adult retarded	21.1	22.3	71.7	73.0
9	Adult retarded	20.6	21.5	61.5	61.8

The 8.1 IQ superiority of the discrimination group in group 3 in Table 2 was the result of a random selection of these subjects from the original pool of group 3 subjects. Although this random selection method was used in determining discrimination subjects in all of the 9 groups only the regular and discrimination subjects in group 3 differed in mean IQ by more than 3 IQ points. This will be considered as needed in later analysis.

Findings for Top-Oriented, Color, Form, and Size Identities

To provide a basis for comparing the groups on top-oriented identity scores, the mean scores for the groups are shown in Table 3a.

The randomized analysis of variance test was used to compare the groups on the 12 top-oriented color, form, and size identity scores. This analysis indicated no significant differences among the regular subjects as well as the discrimination subjects when each score was considered separately across all of the nine groups The mean left to right (L-R) and front to back (F-B) scores in Table 3a were compared for significant differences within each group for color, form, and size by a significance of mean test but no significant differences were found between L-R and F-B scores.

The reader will recall that visualizing the problem in space, the term "top-orientation" refers to the position of the subject in front of the sorting matrix. As he looks at the trays, will he pick up and organize objects which are alike (identities), and later objects which are different (progressions) or will he use some other structure? Also considered is whether or not the left to right placement will be a stronger tendency or whether the front to back will predominate. This could easily be, for example, a tendency from cultural pressure to organize left to right structure.

Color: comparison of top-oriented color identity scores among groups

The top-oriented color identity scores provide data on the tendencies of the groups to pair and group the timulus objects in left to right and front to back horizontal directions in the trays on the basis of color shade (Figure 14).

Table 3a. Top-oriented: mean top-oriented color, form, and size identity scores for all nine regular and discrimination groups

No.		1	2	3	4	5	6	7	8	9	
Level		Hi. 3	Lo. 3	Sup. 6	Hi. 6	Lo. 6	Hi. Ado.	Lo. Ado.	Hi. Adu.	Lo. Adu.	
COLOR	R	7.0	5.7	7.0	6.1	6.1	6.4	6.7	6.4	6.2	
(L-R)	D	5.0	4.4	7.1	6.7	5.8	5.3	5.9	7.0	6.8	
Mean		6.0	5.05	7.05	6.4	5.95	5.85	6.3	6.7	6.5	6.20
	R	6.2	6.6	7.3	7.0	6.2	5.1	7.1	4.2	6.8	
(F-B)	D	5.0	6.8	8.0	5.1	5.0	6.4	5.1	5.5	4.2	
Mean		5.6	6.7	7.65	6.05	5.6	5.75	6.1	4.85	5.5	5.86
FORM	R	7.6	7.5	8.5	8.3	9.1	9.7	10.0	6.4	12.0	
(L-R)	D	11.0	7.2	7.7	11.7	10.0	5.0	9.9	8.2	5.4	
Mean		9.3	7.35	8.1	10.0	9.55	7.35	9.95	7.3	8.7	8.62
	R	8.6	9.7	8.0	7.5	7.6	9.1	10.1	8.4	11.4	
(F-B)	D	6.5	10.1	13.0	9.2	10.2	5.6	12.1	7.5	5.5	
Mean		7.55	9.9	10.5	8.35	8.9	7.35	11.1	7.95	8.45	8.79

Table 3a. Continued

No.		1	2	3	4	5	6	7	8	9	
Level		Hi. 3	Lo. 3	Sup. 6	Hi. 6	Lo. 6	Hi. Ado.	Lo. Ado.	Hi. Adu.	Lo. Adu.	
SIZE	R	10.5	10.7	10.7	9.3	11.6	8.4	10.0	11.5	8.2	
(L-R)	D	14.2	11.2	14.0	11.0	10.3	10.8	12.5	8.7	7.8	
Mean		12.35	10.95	12.35	10.15	10.95	9.6	11.25	10.1	8.0	10.63
	R	9.2	9.3	11.2	10.5	9.1	9.3	8.0	10.0	10.0	
(F-B)	D	9.7	9.7	8.8	14.0	11.8	11.3	11.4	10.1	7.5	
Mean		9.45	9.5	10.0	12.25	10.45	10.3	9.7	10.05	8.75	10.05

A comparison of the mean left to right top-oriented color identity scores with the composite mean of these scores in Table 3a reveals a consistency among the groups in their organization of top-oriented color identities in this direction. The score of low average grade 3 (group 2) proved an exception by deviating from the composite mean (6.20) more than the other groups. This lower score for the left to right direction compared to the group's higher score (6.7) for the front to back color when compared to the composite mean for front to back (5.86) may imply more use of the front to back direction for top-oriented color identity sortings.

The front to back organization of top-oriented color identities also reveals a consistency among the groups. High retarded adults (group 8) showed a deviation by scoring lower (4.85) than the other groups when compared to the composite mean of the groups (5.86). This may imply more use of the left to right mode for them.

The effects of discrimination training in the sorting of left to right and front to back top-oriented color identities was variable. It apparently reduced the tendencies of high average grade 3 (group 1) from 7.0 to 5.0, low average grade 3 (group 2) from 5.7 to 4.4 and high adult retardates (group 6) from 6.4 to 5.3 to use the left to right direction in their sortings, but it did not seem to increase the tendency of other groups to use this direction. With front to back sortings, discrimination training tended to reduce the use of this direction in high average grade 6 (group 4) from 7.0 to 5.1, low adolescent retardates (group 7) from 7.1 to 5.1 and low adult retardates (group 9) from 6.8 to 4.2.

The effects of discrimination training on the organization of front to back and left to right color identities are in general ambiguous and

without clear cut trends. It appears to increase the tendency of the high adult retarded group (group 8) to organize top-oriented color identities in these directions but it does not seem to have this effect on the low retarded groups (groups 7 and 9). The intellectually normal groups reveal no distinct trends for evaluating discrimination effects.

The higher scores of the adult retardates in the use of the left to right direction may reflect their training experiences while employed in a sheltered workshop. Many of their job tasks require using the left to right orientation. The lack of effect of discrimination training with these retardates may reflect a low ability to utilize more information due to their poor assimilation ability based on inadequate "mental structure."

Form: comparison of the top-oriented form identity scores among groups

Top-oriented form identity scores indicate the tendencies of the groups to pair and group the stimulus objects in left to right and front to back horizontal directions on the basis of form (Figure 14).

A comparison of the mean left to right form identity scores with the composite mean of these scores in Table 3a shows variabilities among the groups in their use of this direction for sorting top-oriented form identities. Three groups, high average grade 6 (group 4), low average grade 6 (group 5) and low adolescent retardates (group 7) scored higher than the composite mean (8.62) with scores of 10.0, 9.55, and 9.95 respectively. Low average grade 3 (group 2), high adolescent retardates (group 6) and adult retardates (group 8) scored lower than the composite mean with 7.35, 7.35, and 7.3. The higher and lower scores of these groups when compared to the composite mean may reflect more and less use

of the left to right direction in their sortings. The comparable composite means of 8.62 for left to right and 8.79 for front to back indicate a tendency for the groups to use both directions equally in their sortings.

In the use of the front to back direction, superior grade 6 (group 3) and low adolescent retardates (group 7) obtained scores of 10.5 and 11.1 respectively. These higher than the mean composite score (8.79) may imply a preference for this direction in sorting.

The effects of discrimination training in the use of left to right and front to back directions in sorting top-oriented form identities shows the same inconsistency that typified discrimination scores in top-oriented color identities.

Size: comparison of top-oriented size identity scores among the groups

Top-oriented size identities indicate the tendencies of the groups to pair and group the stimulus objects in left to right and front to back horizontal directions in the trays on the basis of size (Figure 14).

A comparison of the mean left to right and front to back top-oriented size identity scores with their composite means (10.63 and 10.05) indicates a tendency for the groups to use both directions equally in their sortings. High average grade 3 (group 1) and superior grade 6 (group 3) both with means of 12.35 scored higher on their left to right sortings when compared to the composite mean of 10.63 for this direction. This may imply that these groups prefer this direction for their top-oriented size identity sortings.

Six of the nine discrimination groups in left to right size identities and four of the nine groups on front to back size identities showed

higher scores than the regular subjects of their respective groups. Three of the discrimination groups who showed lower scores than their counterparts were retarded groups. The fact that retarded subjects who received discrimination training scored lower than regular subjects on color, form, and size identities in eight out of twelve instances, implies that retarded subjects are not benefitting by such training.

Findings for Top-Oriented Color, Form, and Size Progressions

The results of the randomized analysis of variance test indicated that no significance differences existed among the regular groups and among the discrimination groups on the 12 color, form, and size progression scores when each score was considered separately across all of the nine groups. This lack of significance also indicates that discrimination training did not produce significant differences in the scores of the discrimination groups which separated them from their regular counterparts. This overall effect revealed that discrimination subjects and regular subjects did not differ from each other. An analysis of the effects of discrimination training is also included in this section. Table 3b has top-oriented progression scores.

Color: comparison of top-oriented color progression scores among the groups

Top-oriented color progression scores indicate the tendencies of the groups to sort the stimulus objects left to right and front to back horizontally on the basis of different color shades.

The agreement of the left to right group means with their composite mean (11.48) suggests the groups had about equal preference for this direction in their front-oriented color progressions. This agreement

Table 3b. Top-oriented: mean top-oriented color, form, and size progression scores for all nine regular and discrimination groups

No.		1	2	3	4	5	6	7	8	9	
Level		Hi. 3	Lo. 3	Sup. 6	Hi. 6	Lo. 6	Hi. Ado.	Lo. Ado.	Hi. Adu.	Lo. Adu.	
COLOR	R	11.4	11.4	11.9	11.5	11.2	11.5	11.4	11.2	11.1	
(L-R)	D	12.2	10.8	13.2	10.0	12.5	11.7	12.8	10.4	10.5	
Mean		11.8	11.1	12.55	10.75	11.85	11.6	12.1	10.8	10.8	11.48
	R	10.8	11.3	10.7	11.1	11.2	12.0	11.8	13.2	11.1	
(F-B)	D	12.0	10.8	10.5	11.1	12.7	11.2	13.1	11.7	13.7	
Mean		11.4	11.05	10.6	11.1	11.95	11.6	12.45	12.45	12.4	11.66
FORM	R	11.1	11.2	10.8	10.9	10.3	10.0	10.1	12.8	8.2	
(1R)	D	8.7	10.7	10.4	10.5	11.5	11.5	9.5	11.4	11.7	
Mean		9.9	10.9	10.6	10.7	10.9	10.75	10.0	12.1	9.95	10.64
	R	11.0	9.2	11.9	10.7	12.4	11.0	10.1	9.9	9.2	
(F-B)	D	12.5	9.0	8.0	12.4	9.5	12.8	7.6	13.4	12.5	
Mean		11.75	9.1	9.95	11.55	10.95	11.9	8.85	11.65	10.85	10.72

Table 3b. Continued

No.		1	2	3	4	5	6	7	8	9	
Level		Hi. 3	Lo. 3	Sup. 6	Hi. 6	Lo. 6	Hi. Ado.	Lo. Ado.	Hi. Adu.	Lo. Adu.	
SIZE	R	9.2	8.5	8.7	9.6	8.3	11.0	9.5	7.9	10,3	
(L-R)	D	7.0	8.1	7.4	9.4	10.0	8.6	8.3	10.7	10.4	
Mean		8.1	8.3	8.05	9.5	9.15	9.8	8.9	9.3	10.35	9.05
	R	9.5	10.6	8.7	9.1	9.7	10.0	11.0	9.0	9.2	
(F-B)	D	9.7	9.2	11.4	7.2	9.5	8.9	9.6	7.2	10.0	
Mean		9.6	9.9	10.05	8.05	9.6	9.45	10.3	8.1	9.6	9.40

also exists with the same implications for the groups in front to back color progressions where the composite mean is 11.66. The close agreement of the two composite means (11.48 to 11.66) implies that both directions were used equally by the groups in their sortings.

Discrimination training seemed to have little effect in increasing top-oriented progression scores in the left to right direction except superior grade 6 (group 3) who showed an increase from 13.2 to 11.9. In front to back sorting, the groups indicated increases from discrimination training for high average grade 3 (group 1) from 10.8 to 12.0, low adolescent retardates (group 7) from 11.8 to 13.1 and low adult retarded (group 9) from 11.1 to 13.7. In general, discrimination training did not show trends in increasing the sorting scores of the intellectually normal and retarded groups in top-oriented color progressions.

Form: comparison of top-oriented form progression scores among the groups

Top-oriented form progression scores indicate the tendencies of the groups to sort the stimulus objects horizontally from left to right and front to back on the basis of different forms.

The consistency of the groups means in top-oriented color progressions was also evident in their sortings of left to right and front to back top-oriented form progressions.

In left to right top-oriented form progressions there is little variability among the groups when they are compared with their composite mean of 10.64 for this direction. This implies that the groups used this direction for their sortings to a similar degree.

In front to back top-oriented form progressions there was also

little variability among the groups when compared to their composite mean of 10.72. As with top-oriented form progressions the small variabilities imply that the groups used this direction for their sortings to an equal degree. The close agreement of the composite means of 10.64 and 10.72 suggests the groups used both directions about equally in their top-oriented progressions sortings.

Discrimination training increased the scores of two retarded groups in the front to back direction; high adult retardates (group 8) increased from 9.9 to 13.4, and the low adult retardates (group 9) from 9.2 to 12.5. The effects of discrimination training with the intellectually normal groups on top-oriented form progressions show variabilities that do not indicate trends.

Size: comparison of top-oriented size progressions scores among the groups

Top-oriented size progressions indicate the tendencies of the groups to sort the stimulus objects horizontally in left to right and front to back directions on the basis of different size.

A comparison of the group mean scores for left to right size identities indicate that three groups, high average grade 3 (group 1) with a mean of 8.1, low average grade 3 (group 2) with a mean of 8.3 and superior grade 6 (group 3) with a mean of 8.05 scored lower than the composite mean of 9.05. These lower scores may imply that these groups use the front to back direction more than the left to right direction for their top-oriented size progression sortings.

In front to back sorting of top-oriented size identities high average grade 6 (group 4) with a mean of 8.05 and high adolescent retardates (group 8) with a mean of 8.1 scored lower than the composite mean of

9.40. Their higher left to right means of 9.5 and 9.3 suggests they prefer this direction for their top-oriented size progression sortings over the front to back approach.

A comparison of regular and discrimination groups for both directions indicates that discrimination training increased more front-oriented color and size progression scores than front-oriented form progressions scores for both retarded and intellectually normal groups.

Findings for Front-Oriented Color, Form, and Size Identities

The randomized analysis of variance test was used to compare the groups on the 12 front-oriented color, form, and size identity scores. This analysis revealed no significant differences among the regular subjects as well as the discrimination subjects when each score was considered separately across all of the nine groups. This lack of significance also indicated that discrimination training did not produce significant differences in the scores of the discrimination groups which separated them from the regular groups. This overall effect showed that these groups did not differ from each other. An analysis of the effects of discrimination training is also included in this section.

A significance of mean test was used to test each group on their use of the left to right (L-R) and front to back (F-B) directions for color, form, and size identities. It will be noted that several significant differences appeared in individual groups, and for groups as a whole on the gross color, form, and size comparisons. To provide a basis for comparing the groups on front-oriented identities the mean scores for the nine groups are included in Table 4a.

Table 4a. Identities: mean front-oriented color, form, and size identity scores for all nine regular and discrimination groups

No.		1	2	3	4	5	6	7	8	9	
Level		Hi. 3	Lo. 3	Sup. 6	Hi. 6	Lo. 6	Hi. Ado.	Lo. Ado.	Hi. Adu.	Lo. Adu.	
COLOR	R	6.5	5.5	6.7	6.7	6.7	6.4	6.9	6.5	6.5	
(L-R)	D	4.7	4.5	7.2	6.2	5.8	5.5	5.4	7.0	7.2	
Average		5.6	5.0	6.95	6.45	6.25	5.95	6.5	6.75	6.85	6.14
	R	6.2	6.7	6.7	7.6	6.4	7.2	6.4	5.4	7.5	
(F-B)	D	7.5	5.1	9.0	6.0	6.7	8.4	5.9	11.2	11.3	
Average		6.85	5.9	7.85	6.8	6.55	7.8	6.15	13.3	9.4	7.88
FORM	R	8.0	8.0	8.4	7.8	8.6	9.7	9.7	5.7	11.7	
(L-R)	D	10.1	7.8	7.1	10.8	9.8	5.4	9.8	7.7	5.8	
Average		9.55	7.9	7.8	9.3	9.2	7.55	9.75	6.7	8.75	8.48
	R	7.4	5.8	7.2	5.6	6.1	6.2	6.4	7.1	6.3	
(F-B)	D	4.5	7.5	5.7	5.4	7.5	5.9	7.5	7.1	6.8	
Average		5.95	6.65	6.45	5.5*	6.8*	6.05	6.95*	7.1	6.55*	6.44

Table 4a. Continued

No.		1	2	3	4	5	6	7	8	9	
Level		Hi. 3	Lo. 3	Sup. 6	Hi. 6	Lo. 6	Hi. Ado.	Lo. Ado.	Hi. Adu.	Lo. Adu.	
SIZE	R	9.9	10.2	11.0	9.3	10.6	7.5	9.5	10.5	7.8	
(L-R)	D	12.5	10.4	12.8	11.8	10.8	8.6	12.0	8.4	7.2	
Average		11.2	10.3	11.9	10.55	10.7	8.05	10.75	9.45	7.5	10.03
	R	6.4	7.7	5.7	7.7	6.5	7.3	7.5	6.2	7.0	
(F-B)	D	6.5	6.2	9.5	5.5	10.1	7.0	7.0	6.4	7.1	
Average		6.45**	6.95*	7.6**	6.6	8.3	7.15	7.3*	6.3*	7.05	7.07

As previously mentioned, "front-orientation" refers to the organization of the stimulus objects vertically down through the sorting matrix. The questions, "Will the subjects organize their sortings on the basis of like characteristics of the objects (identities) or differences of the objects (progressions) and in what direction?" (left to right or front to back) were also asked for front-oriented sortings. "Will special orientation with the objects and the trays increase the subjects' tendency to sort on the basis of like characteristics (identities) or different characteristics (progressions)?" was another important question considered. It may be that higher scores for sorting on the vertical than the horizontal direction indicate a higher form of conceptual development than was indicated by horizontal sorting.

Color: comparison of front-oriented color identity scores among the groups

Front-oriented color identity scores indicate tendencies of the groups to sort the stimulus objects from left to right and front to back vertically among the trays on the basis of identical color shade.

The mean scores for all groups reveal little variability from their composite mean of 6.14 in front-oriented left to right color identities. This implies the groups were about equal in their sortings in this direction and modality.

More variability was shown in front to back front-oriented color identities. High average grade 3 (group 1) with 6.85, low average grade 3 (group 2) with 5.98, high average grade 6 (group 4) with 6.80, low average grade 6 (group 5) with 6.25 and low adolescent retardates (group 7) with 6.15 all showed lower scores than the composite score of 7.88. This may indicate a tendency to use the front to back direction less

than the other groups for their front-oriented color identities. The two adult retarded groups, the high (group 8) with 13.3 and the low (group 9) with 9.4, scored higher than the composite mean which may indicate more use of this direction than the other groups.

Discrimination training in the left to right direction did not appear to increase front-oriented color identity scores but in the front to back direction it increased high average grade 3 (group 1) from 6.2 to 7.5, superior grade 6 (group 3) from 6.7 to 9.0, high adolescent retardates (group 6) from 7.2 to 8.4, high adult retardates from 5.4 to 11.2, and low adolescent retardates from 7.5 to 11.3. Discrimination training increased the scores of retarded groups more instances than it increased scores of intellectually normal groups.

Form: comparison of front-oriented form identity scores among the groups

Front-oriented color identity scores indicate tendencies of the groups to sort the stimulus objects from left to right and front to back vertically among the trays on the basis of identical form.

Several of the mean scores of the groups in left to right front-oriented form identities are lower than the composite mean of 8.99. Low average grade 3 (group 2) with 7.9, superior grade 6 (group 3) with 7.8, high adolescent retardates (group 6) with 7.5, and high adult retardates (group 8) with 6.7 show lower scores that may indicate that these groups use the left to right direction less than the other groups in their front-oriented left to right form identity sortings.

The front to back direction shows less variability of the groups from their composite mean of 6.44 which implies the groups use this direction about equally on their sortings.

Table 4a shows that four groups, high average grade 6 (group 4), low average grade 6 (group 5), low adolescent retardates (group 7) and low adult retardates (group 9), used the left to right direction significantly more than the front to back direction in their front-oriented sortings of form.

Discrimination training increased the left to right front-oriented form identity scores of high average grade 3 (group 1) from 8.0 to 10.1, high average grade 6 (group 4) from 7.8 to 10.8 and low average grade 6 (group 5) from 8.6 to 9.8.

In front to back sortings low average grade 3 (group 2) from 5.8 to 7.5, low average grade 6 (group 5) from 6.1 to 7.5 and low adolescent retardates from 6.4 to 7.5 increased their scores as the result of discrimination training. In general, the intellectually normal groups benefitted more from discrimination training than the retarded groups in front-oriented color identities.

Size: comparison of front-oriented size identity scores among the groups

Front-oriented size identity scores indicate tendencies of the groups to sort the stimulus objects from left to right and front to back vertically among the trays on the basis of identical size.

The mean left to right front-oriented size identity scores indicate that superior grade 6 (group 3) scored the highest with a 11.9. This score compared to the composite mean of 10.03 implies that this group used this direction more than other groups for its front-oriented size identity sortings. The opposite was true with two retarded groups, high adolescents (group 6) with 8.05 and low adults (group 8) with 7.5. These groups when compared with the composite mean of 10.03 indicated less

sortings in this direction.

The front to back direction showed less variability. With the exception of low average grade 6 (group 5), who scored 8.3 compared to the composite mean of 7.07, the groups showed by their consistent agreement with the composite mean that they used this direction about equally in their front-oriented size identity sortings.

Three intellectually normal groups, high and low grade 3 (groups 1 and 2) and superior grade 6 (group 3), and two retarded groups, low adolescents (group 7) and high adult retardates (group 8), used left to right significantly more than front to back in their front-oriented size identity sortings.

Discrimination training increased the scores in the left to right in five instances and front to back in one instance. Low adolescent retardates (group 7) showed the most increase, from 9.5 to 12.0 in left to right sortings and low average grade 6 (group 5) the most increase, from 6.5 to 10.1, in front to back sorting.

A significance of means test indicates that discrimination training significantly increased the overall scores at the .01 level.

Findings for Front-Oriented Color, Form, and Size Progressions

The randomized analysis of variance test was used to compare the groups on the twelve front-oriented color, form and size progression scores. This analysis indicated no significant differences among the regular subjects and among the discrimination subjects when each score was considered separately across all of the nine groups and that discrimination training did not produce significant differences in the discrimination groups which separated them from the regular groups.

A significance of mean test was used to test each group on their use of the left to right (L-R) and front to back (F-B) directions for color, form, and size. An analysis of the effects of discrimination training is also included in the following section. The front-oriented scores for all the nine groups are expressed as means in Table 4b to provide a basis for analysis.

Color: comparison of front-oriented color progression scores among the groups

Front-oriented color progression scores reveal tendencies of the groups to sort the stimulus objects from left to right and front to back vertically among the trays on the basis of different color shades.

The mean left to right front-oriented color progression scores in Table 4b show little variability with their composite mean of 11.83. This may reveal that the groups use this direction for their front-oriented color progression sortings about equally.

Little variability was also evident for the front-back direction. The lack of deviations from the composite mean of 11.09 also suggests that the groups used this direction about equally in their sortings.

Discrimination training was effective in increasing the left to right score of high average grade 3 (group 1) from 11.7 to 13.5 and superior grade 6 (group 3) from 12.0 to 13.3. In the front to back direction low average grade 3 (group 2) increased from 10.0 to 11.5 and low adult retardates from 10.8 to 11.7.

Form: comparison of front-oriented form progression scores among the groups

Front-oriented form progression scores reveal tendencies of the groups to sort the stimulus objects from left to right and front to back

Table 4b. Progressions: mean front-oriented color, form, and size progression scores for all nine regular and discrimination groups

No.		1	2	3	4	5	6	7	8	9	
Level		Hi. 3	Lo. 3	Sup. 6	Hi. 6	Lo. 6	Hi. Ado.	Lo. Ado.	Hi. Adu.	Lo. Adu.	
COLOR	R	11.7	12.3	12.0	11.4	11.0	11.4	12.8	11.2	11.3	
(L-R)	D	13.5	12.4	13.5	11.7	11.8	11.7	12.3	10.2	10.8	
Average		12.6	12.35	12.75	11.55	11.4	11.55	12.55	10.7	11.05	11.83
	R	12.2	11.7	11.5	10.7	11.0	10.7	10.0	12.1	10.8	
(F-B)	D	11.1	12.5	10.1	10.5	10.8	10.5	11.5	12.0	11.7	
Average		11.65	12.1	10.8	10.6	10.9	10.6	10.75	12.05	11.25	11.09
FORM	R	11.2	11.2	11.4	10.8	9.8	9.9	10.0	12.7	8.3	
(L-R)	D	8.7	10.2	10.8	10.5	11.6	11.1	9.9	11.0	11.7	
Average		9.95	10.7	11.1	10.65	10.7	10.5	9.95	11.85	10.0	10.60
	R	12.3	13.2	12.2	13.2	12.0	13.2	12.4	11.2	14.2	
(F-B)	D	12.8	12.1	13.4	13.8	14.6	10.7	12.2	11.8	13.0	
Average		12.55	12.65	12.8	13.5	13.3	11.95	12.3	11.5	13.6	12.67

Table 4b. Continued

No.		1	2	3	4	5	6	7	8	9	
Level		Hi. 3	Lo. 3	Sup. 6	Hi. 6	Lo. 6	Hi. Ado.	Lo. Ado.	Hi. Adu.	Lo. Adu.	
SIZE	R	9.2	8.9	8.5	9.8	8.1	11.2	9.6	8.4	10.2	
(L-R)	D	7.2	8.5	7.7	9.8	10.1	8.8	8.5	10.1	10.5	
Average		8.2	8.7	8.1	9.8	9.1	10.0	9.25	9.25	10.35	9.19
	R	11.4	11.5	14.8	11.1	11.7	11.8	11.1	12.9	12.1	
(F-B)	D	12.0	13.1	11.4	14.1	10.2	12.3	12.3	11.2	12.5	
Average		11.7*	12.3**	13.1**	12.6	10.95	12.05	11.7*	12.05*	12.3**	12.08

*For significance at the .05 level
**For significance at the .01 level

vertically among the trays on the basis of different form.

The only slight variabilities shown by the groups in front-oriented color progressions is also evident in front-oriented form progressions, as seen in Table 4b. The favorable comparison of the left to right group means with the composite mean of 10.60 and in front to back with the composite mean of 12.67 may imply that the groups sort about equally in each direction.

Discrimination training only increased two groups from left to right, low average grade 6 (group 5) from 9.8 to 11.6 and low adult retardates from 8.3 to 11.7. In front to back superior grade 6 (group 3) increased from 12.2 to 13.4 and low average grade 6 (group 5). In general, discrimination training showed only isolated increases in both directions.

Size: comparison of front-oriented size progression scores among the groups

Front-oriented size progressions reveal tendencies of the groups to sort the stimulus objects from left to right and front to back vertically among the trays on the basis of different size.

A comparison in Table 4b of the group mean scores for left to right and front to back front-oriented size progressions with their respective composite means of 9.19 for left to right and 12.08 for front to back shows the same consistency evident in both front-oriented color and form. This implies that the groups were comparable in their use of the left to right direction and comparable for front to back also.

Five groups who used the front to back direction significantly more than left to right in their horizontal size progression sortings, high and low grade 3 (groups 1 and 2), superior grade 6 (group 3), low adolescent retardates (group 7) and high adult retardates (group 8), reversed

on their vertical size progressions by using the front to back direction significantly more. The low adult retardates (group 9) also used front to back significantly more with vertical size.

The effects of discrimination training were again isolated. Three intellectually normal groups, low average 6 (group 5) increased from 8.1 to 10.1 in left to right. In front to back, low average grade 3 (group 2) increased from 11.5 to 13.1 and high average grade 6 (group 4) from 11.1 to 14.1. Two retarded groups, high adults (group 8) from 8.4 to 10.1 in left to right and low adolescents (group 7) from 11.1 to 12.3 showed increases.

Comparison of Top-Oriented Identity and Top-Oriented Progression Scores Within Each Group

To compare top-oriented identity and top-oriented progression scores within each group, the left to right and front to back mean scores for both regular and discrimination subjects were combined to obtain a single identity and single progression score for each group. These scores shown in Table 5a were tested for significant differences by a significance of the mean test.

Comparison of top-oriented color identity and top-oriented color progression scores within each group

Table 5a indicates that all groups have significantly higher top-oriented color progression scores than top-oriented color identity scores. This means that their discrimination of color shades was more effective in their horizontal sortings than their color shade groupings. The similarity of the difference scores among the groups reveals the groups about equal in their preference for sorting on the basis of changing rather than identical color shades.

Table 5a. Top-oriented: the combined mean left to right and front to back top-oriented identity and progression scores for the nine regular and discrimination groups

	1	2	3	4	5	6	7	8	9	
Ident.	23.2	23.5	29.4	29.4	23.1	23.2	24.8	23.1	24.0	23.8
COLOR										
Prog.	46.4	44.3	46.3	43.7	47.6	46.4	49.1	46.5	46.4	46.3
Difference	23.2 **	20.8 **	26.9 **	18.8 **	24.5 **	23.2 **	24.3 **	23.4 **	22.4 **	
Ident.	33.7	34.5	37.2	36.7	36.9	29.4	42.1	30.5	34.3	35.0
FORM										
Prog.	43.3	40.1	41.1	44.5	43.7	41.4	37.7	47.5	41.6	42.3
Difference	9.6 *	5.6	3.9	7.8	6.8	12.0	4.4	17.0 **	7.3	
Ident.	43.6	40.9	44.7	43.8	42.8	39.8	41.9	40.3	33.4	41.2
SIZE										
Prog.	35.4	36.4	36.2	35.3	37.5	38.5	37.6	38.7	38.3	37.1
Difference	8.2	4.5	8.5	8.5	5.3	1.3	4.3	1.6	4.9	

*For significance at the .05 level
**For significance at the .01 level

Comparison of top-oriented form identity scores and top-oriented form progressions scores within each group

Table 5a shows the top-oriented form progression scores higher than the top-oriented form identity scores for all groups except the low adolescent retardates (group 7). Two groups, high average grade 3 (group 1) and high adult retardates (group 8) show a significant tendency in this direction. This preference for form progressions over form identities indicates the group sorted more on the basis of different (changing) form than on the basis of identical form. The one exception, low adolescent

retardates (group 7) showed a small preference for identical form.

The variability of the difference scores among the group reveals degrees of preference for sorting progressions more than identities in this dimension.

Comparison of top-oriented size identity and top-oriented size progression scores within each group

The preference for progressions over identities in top-oriented color and form was reversed for top-oriented size. As shown in Table 5a, all groups except the low adult retardates (group 9) have higher size identity than size progression scores. This reversal means that all groups except the low adult retardates (group 9) sorted the stimulus objects more on the basis of identical sizes than on the basis of different sizes.

It is apparent the groups, in general, responded more to differences than similarities with color and size and more to similarities than differences with size in their sortings of the stimulus objects in the horizontal dimension. This clear shift reveals the subjects sorting different colors and different forms while at the same time grouping similar sizes.

Comparison of Front-Oriented Identity and Front-Oriented Progression Scores Within Each Group

Table 5b includes combined identity and progression scores for comparing the nine regular and discrimination groups on color, form, and size. These scores were also tested for significant differences by a test measuring the significance of the difference between means.

Table 5b. Front-oriented: the combined mean left to right and front to back front-oriented identity and progression scores for the nine regular and discrimination groups

	1	2	3	4	5	6	7	8	9	
Ident.	27.9	21.8	29.6	26.5	25.6	27.5	24.6	24.9	28.5	25.9
COLOR										
Prog.	49.8	48.9	47.1	44.3	44.6	44.3	46.6	46.0	44.6	46.2
Difference	24.9 **	27.1 **	17.5 **	17.8 **	19.0 **	16.8 **	22.0 **	21.1 **	16.1 **	
Ident.	30.0	29.1	28.4	29.6	32.0	27.2	33.4	27.6	30.6	29.4
FORM										
Prog.	45.0	46.7	47.8	48.3	48.0	45.0	44.5	46.7	47.2	46.5
Difference	15.0 **	17.6 **	19.4 **	18.7 **	16.0 **	17.8 **	11.1 **	19.1 **	16.6 **	
Ident.	36.3	34.5	39.0	44.3	38.0	30.4	36.1	31.5	30.3	34.5
SIZE										
Prog.	39.8	42.0	42.4	44.8	40.1	44.1	41.5	42.6	45.3	42.5
Difference	3.5	7.5	3.4	.5	2.1	13.7 **	5.4	11.1 *	15.0 **	

*For significance at the .05 level
**For significance at the .01 level

Comparison of front-oriented color identity and front-oriented color progression scores within each group

As indicated in Table 5b, all groups scored significantly higher on front-oriented color progressions than on front-oriented color identities. This indicates a preference for vertically sorting the stimulus objects on the basis of different color shades rather than identical color shades. The similar difference scores among the groups show them about equal in their preference for different color shades over identical

color shades in their vertical sortings.

Comparison of front-oriented form identities and front-oriented form progression scores within each group

The significant preference of the groups for vertically sorting front-oriented color on the basis of differences also applies to their vertical sortings of front-oriented form. Their lower difference scores for form than for color indicate less of a preference for sorting on the basis of form differences but the similarity of these scores among the groups indicate about equal preference for this approach.

Comparison of front-oriented size identity and size progression scores within each group

The trend shown by the groups for sorting the stimulus objects on the basis of differences in front-oriented color and form continues with front-oriented size. Their clear shift from color and form progressions to size identities that occurred in the groups' top-oriented sorting did not occur in front-oriented sorting. Thus, the horizontal layers showed more of this effect than the vertical layers. The low difference scores of the intellectually normal subjects (groups 1 through 5) reveal only a slight preference for vertically sorting on the basis of size differences but the significantly higher progression scores of three retarded groups (groups 6, 8, and 9) show a definite preference for this approach.

In vertical sorting, the intellectually normal and retarded groups without exception, responded to the color, form, and size differences of the stimulus objects in their sorting. Their responses to differences over likenesses was most pronounced with color, less pronounced with form and slightly pronounced with size.

Summary of top-oriented identity and top-oriented progression scores within each group

With color, all groups sorted significantly more on the basis of changing color shade (progressions) than on like identical) color shades in both the horizontal and vertical dimensions.

This responding to differences more than similarities also occurred with form, significantly in the horizontal dimension and clearly in the vertical dimension.

For horizontal sorting of size a complete reversal from differences (progressions) in color and form to likenesses (identities) occurred. Here the groups clearly shifted to grouping identical sizes together. While preference for sorting on the basis of size differences decreased in the vertical dimension, it did not shift over to sorting on size likenesses (identities).

Findings for Top-Oriented Color, Form, and Size Identity and Progression Scores Within Each Group

As the reader will recall, top-oriented identity scores reveal the tendencies of the groups to sort the stimulus objects on the basis of identical color shade, identical form, and identical size horizontally within the trays of the sorting matrix while top-oriented progression scores reveal the tendencies of the groups to sort the stimulus objects on the basis of different (changing) color shade, different form and different size horizontally within the trays.

To provide a basis for comparing the use of color, form, and size in top-oriented sorting within each group, a randomized analysis of variance test was completed by IBM computer to investigate whether significant differences in the use of color, form and size for sorting occurred in

each group. The results of this analysis are indicated in Table 6a.

In instances where the randomized analysis of variance indicated significance, a significance of means test was applied to discover where the significance lay, between color, form, or size.

Both top-oriented identity and progression scores are included in Table 6a so that comparisons for each group in the use of identical (identity) and different (progressions) characteristics of the stimulus objects could be made.

The use of color, form, and size in sorting top-oriented identities and progressions within each group

Group 1 (high average grade 3). Table 6a shows that the regular and discrimination subjects in high average grade 3 have significantly higher top-oriented size identity scores than form and color scores. This indicates that this group responded more to identical size than identical form and color in their horizontal sortings.

In top-oriented progressions the regular and discrimination subjects showed no significant differences in their scores. This indicates no significant preferences for color, form, and size in their horizontal sorting of the objects on the basis of differences (progressions).

Group 2 (low average grade 3). Table 6a shows the scores for the regular subjects of low average grade 3 differ significantly. This indicates that these subje-ts responded to identical size significantly more than identical color and form but not to form significantly more than size. The scores of the discrimination subjects indicate they did not respond differentially to identical color, form, and size in their horizontal groupings (identities).

The top-progression scores reveal no significant differences

Table 6a. Top-oriented identities and progressions: mean top-oriented color, form, and size identity and progression scores for regular and discrimination subjects of each group

Group	Treatment		Color	Form	Size	Sig.
Top identities						
1. High average grade 3		R	13.2	16.2	19.8	
		D	10.0	17.5	24.0	
	Color	R		*	**	Yes
		D		**	**	Yes
	Form	R			**	Yes
		D			**	Yes
2. Low average grade 3		R	12.3	17.2	20.1	
		D	11.2	17.4	21.0	
	Color	R		*	**	Yes
		D		NS	NS	No
	Form	R			NS	No
		D			NS	No
3. Superior grade 6		R	14.3	16.5	22.0	
		D	15.1	20.7	22.8	
	Color	R		NS	**	Yes
		D		NS	NS	No
	Form	R			**	Yes
		D			NS	No
4. High average grade 6		R	13.1	15.8	19.8	
		D	11.8	21.0	25.0	
	Color	R		NS	NS	No
		D		NS	NS	No
	Form	R			NS	No
		D			NS	No
5. Low average grade 6		R	12.3	16.8	20.8	
		D	10.8	20.2	22.2	
	Color	R		**	**	Yes
		D		NS	NS	No
	Form	R			**	Yes
		D			NS	No
6. High adolescent retarded		R	11.5	18.8	17.7	
		D	11.7	10.6	22.1	
	Color	R		NS	NS	No
		D		**	**	Yes
	Form	R			NS	No
		D			NS	No

Table 6a. Continued

Group	Treatment		Color	Form	Size	Sig.
7. Low adolescent retarded		R	13.8	20.1	18.0	
		D	11.0	22.0	23.9	
	Color	R		NS	NS	No
		D		**	**	Yes
	Form	R			NS	No
		D			NS	No
8. High adult retarded		R	10.7	14.8	21.6	
		D	12.5	15.8	18.8	
	Color	R		**	**	Yes
		D		NS	NS	No
	Form	R			**	Yes
		D			NS	No
9. Low adult retarded		R	13.1	23.4	18.2	
		D	11.1	11.0	15.4	
	Color	R		**	**	Yes
		D		NS	NS	No
	Form	R			**	Yes
		D			NS	No
Top progressions						
1. High average grade 3		R	22.2	22.2	18.7	
		D	24.2	21.2	16.7	
	Color	R		NS	NS	No
		D		NS	NS	No
	Form	R		NS	NS	No
		D		NS	NS	No
2. Low average grade 3		R	22.7	20.5	19.2	
		D	21.7	19.7	17.4	
	Color	R		NS	NS	No
		D		NS	NS	No
	Form	R			NS	No
		D			NS	No
3. Superior grade 6		R	22.6	22.7	17.5	
		D	23.8	18.4	18.8	
	Color	R		NS	**	Yes
		D		NS	NS	No
	Form	R			**	Yes
		D			NS	No

Table 6a. Continued

Group	Treatment		Color	Form	Size	Sig.
4. High average grade 6		R	22.7	21.7	18.7	
		D	21.1	23.0	16.7	
	Color	R		NS	NS	No
		D		NS	NS	No
	Form	R			NS	No
		D			NS	No
5. Low average grade 6		R	22.4	22.7	18.0	
		D	25.2	21.0	19.5	
	Color	R		NS	**	Yes
		D		NS	NS	No
	Form	R			**	Yes
		D			NS	No
6. High adolescent retarded		R	23.5	21.0	21.1	
		D	22.9	24.3	17.5	
	Color	R		NS	NS	No
		D			**	Yes
	Form	R			NS	No
		D			**	Yes
7. Low adolescent retarded		R	23.2	20.2	20.5	
		D	25.9	17.5	17.9	
	Color	R		NS	NS	No
		D		*	**	Yes
	Form	R			NS	No
		D			**	Yes
8. High adult retarded		R	24.5	22.7	17.0	
		D	22.1	24.8	18.0	
	Color	R		*	**	Yes
		D		**	**	Yes
	Form	R			*	Yes
		D			**	Yes
9. Low adult retarded		R	22.2	17.5	19.5	
		D	24.2	24.2	20.4	
	Color	R		NS	NS	No
		D		NS	NS	No
	Form	R			NS	No
		D			NS	No

*For significance at the .05 level **For significance at the .01 level

between color, form, and size for regular and discrimination groups. This indicates they did not respond differently to the differences (progressions) of color, form, and size.

Group 3 (superior grade 6). Table 6a shows that regular subjects of superior grade 6 have significantly higher top-oriented size identity scores than color and form scores. This means they were dominated by their discrimination of identical size and thereby grouped on identical size more than identical color and form. The discrimination subjects of this group showed no such characteristic by not grouping the stimulus objects significantly more on one dimension (color, form, or size) than the other dimensions.

In top-oriented progression the regular subjects show significantly higher color and size scores than form scores. This reversal from identity scores indicates they responded more to identical size than size differences in their horizontal sortings. Their significantly higher color and size scores for top progressions indicate they responded more to the differences of these dimensions in their horizontal sortings. The lack of significant differences for the discrimination subjects on top progressions indicates they did not respond differentially to color, form, and size differences. In toehr words, they were taking these factors into account simultaneously.

Group 4 (high average grade 6). As shown in Table 6a, the top identity and progression scores for the regular and discrimination subjects in high average grade 6 did not differ significantly. This indicates that these subjects did not respond significantly different to color, form, and size in sorting groups (identities) and differences (progressions) in the horizontal dimension.

Group 5 (low average grade 6). The regular subjects of low average grade 6 show significantly higher top-identity size scores, as indicated in Table 6a. This reveals that their perceptions were dominated

by identical (identity) size more than identical color and form. The scores of the discrimination subjects reveal no such perceptual dominance by either color, form, or size in their grouping of identities.

The top-progression scores indicate color and form scores significantly higher than size for the regular subjects. The lower response to size differences (progressions) by the regular subjects agrees with their high response to grouping identical size in top identities. The discrimination subjects reveal no significant differences in their responses to differences (progressions) of color, form, and size in their horizontal sortings.

Group 6 (high adolescent retardates). As seen in Table 6a, the regular subjects of the high adolescent retardates show differend modes of responding to color, form, and size in horizontal identities and progression. Their top-identity scores reveal a significant tendency to group the objects more on identical form and size but their top-progressions scores reveal no significant differences in their responses to color, form, and size differences.

The discrimination subjects do not show preferential responses in their groupings (identities) of color, form,and size but their top-progression scores show they significantly preferred to sort the objects on the basis of size and form differences than color differences.

Group 7 (low adolescent retardates). As shown in Table 6a, the top identity and top progression scores of the low adolescent retarded regular subjects indicate no significant differences. This lack of significance means that these subjects did not respond differently to color, form, and size by showing a preference for one of these dimensions in sorting groupings (identities) and differences (progressions) on the

horizontal dimension.

The discrimination subjects show a significantly higher top-oriented size and form scores than color score which indicates a preference for grouping (identities) on size and form but their preference over form was not significant. Their top-progression color score was significantly higher than form and size which indicates that color differences (progressions) were responded to significantly more than form and size differences in the horizontal dimension.

Group 8 (high adult retardates). Table 6a indicates that the regular subjects of the high adolescent retardates have significantly higher top-identity scores for size than color and form. This means that these subjects discriminated size likenesses (identities) more than form and color likenesses and more form likenesses than color likenesses. The discrimination subjects did not respond significantly different to color, form, and size likenesses (identities).

The top-progression scores for the regular subjects show significantly more response to color differences (progressions) than form and size differences and more response to form differences than size differences. The discrimination subjects reveal significantly more sorting of form differences (progression) than color and size differences and significantly more response to color differences than size differences.

Group 9 (low adult retardates). Table 6a indicates that the regular subjects of the low adult retarded group scored significantly higher on top-oriented form than on top-oriented color and size and significantly higher on size than color. This dominance of form indicates that the regular subjects were influenced by the identical size characteristics of the stimulus objects more than identical color shades

and forms in their horizontal sortings.

The top-oriented scores for both regular and discrimination subjects do not differ. This indicates that the low adult retarded group as a whole did not respond preferentially to the differences in color shade, form, or size.

Findings for Front-Oriented Color, Form, and Size Identity and Progression Scores Within Each Group

As previously stated, front-oriented identity scores reveal the tendencies of the groups to sort the stimulus objects on the basis of identical color shade, identical form and identical size vertically among the trays of the sorting matrix while front-oriented progression scores reveal the tendencies of the groups to sort the stimulus objects on the basis of different (changing) color shade, different form and different size vertically among the trays.

As with top-oriented identity and progression scores in the previous section a randomized analysis of variance test was used to investigate whether significant differences in the use of color, form, and size for sorting occurred in each group.

In instances where the randomized analysis of variance indicated significance, a significance of means test was applied to discover where the significance lay, between color, form, or size.

Both top-oriented identity and progression scores are included in Table 6b so that comparisons for each group in the use of identical (identity) and different (progression) characteristics of the stimulus objects could be made.

Table 6b. Front-oriented identities and progressions: mean front-oriented color, form, and size identity and progression scores for regular and discrimination subjects of each group

Group	Treatment		Color	Form	Size	Sig.
Front identities						
1. High average grade 3		R	12.7	15.5	16.3	
		D	12.2	14.7	19.1	
	Color	R		NS	NS	No
		D		NS	NS	No
	Form	R		NS	NS	No
		D		NS	NS	No
2. Low average grade 3		R	12.7	15.5	16.3	
		D	9.7	15.4	16.7	
	Color	R		*	**	Yes
		D		**	**	Yes
	Form	R			**	Yes
		D			NS	No
3. Superior grade 6		R	13.5	15.6	16.7	
		D	16.2	12.8	22.4	
	Color	R		NS	NS	No
		D		NS	NS	No
	Form	R			NS	No
		D			NS	No
4. High average grade 6		R	14.3	13.5	17.1	
		D	12.2	16.2	17.4	
	Color	R		NS	NS	No
		D		NS	NS	No
	Form	R			NS	No
		D			NS	No
5. Low average grade 6		R	13.2	14.7	17.1	
		D	12.6	15.3	21.0	
	Color	R		NS	NS	No
		D		NS	NS	No
	Form	R			NS	No
		D			NS	No
6. High adolescent retarded		R	13.6	15.9	14.8	
		D	13.9	11.3	15.6	
	Color	R		NS	NS	No
		D		NS	NS	No
	Form	R			NS	No
		D			NS	No

Table 6b. Continued

Group	Treatment		Color	Form	Size	Sig.
7. Low adolescent retarded		R	13.3	16.2	17.1	
		D	11.3	17.3	19.1	
	Color	R		NS	NS	No
		D		**	**	Yes
	Form	R			NS	No
		D				No
8. High adult retarded		R	12.6	12.8	16.7	
		D	12.4	14.8	14.8	
	Color	R		NS	**	Yes
		D		NS	NS	No
	Form	R			**	Yes
		D			NS	No
9. Low adult retarded		R	13.8	18.0	14.8	
		D	14.8	12.7	14.4	
	Color	R		**	NS	Yes
		D		NS	NS	No
	Form	R			**	Yes
		D			NS	No
Front progressions						
1. High average grade 3		R	24.0	23.6	20.7	
		D	24.7	21.5	19.2	
	Color	R		NS	**	Yes
		D		NS	NS	No
	Form	R			**	Yes
		D			NS	No
2. Low average grade 3		R	24.1	24.5	20.5	
		D	25.0	22.4	21.7	
	Color	R		NS	**	Yes
		D		NS	NS	No
	Form	R			**	Yes
		D			NS	No
3. Superior grade 6		R	23.5	23.7	23.4	
		D	23.7	24.2	28.8	
	Color	R		NS	NS	No
		D		NS	NS	No
	Form	R			NS	No
		D			NS	No

Table 6b. Continued

Group	Treatment		Color	Form	Size	Sig.
4. High average grade 6		R	22.2	24.1	21.0	
		D	22.2	24.4	24.0	
	Color	R		**		Yes
		D		NS	NS	No
	Form	R			**	Yes
		D			NS	No
5. Low average grade 6		R	22.0	21.8	19.9	
		D	22.7	26.2	20.3	
	Color	R		NS	NS	No
		D		NS	NS	No
	Form	R			NS	No
		D			NS	No
6. High adolescent retarded		R	22.2	23.1	23.0	
		D	22.2	21.8	21.1	
	Color	R		NS	NS	No
		D		NS	NS	No
	Form	R			NS	No
		D			NS	No
7. Low adolescent retarded		R	22.9	22.4	20.8	
		D	23.8	22.1	20.8	
	Color	R		NS	NS	No
		D		NS	NS	No
	Form	R			NS	No
		D			NS	No
8. High adult retarded		R	23.3	23.9	21.3	
		D	22.2	22.8	21.4	
	Color	R		NS	NS	No
		D		NS	NS	No
	Form	R			NS	No
		D			NS	No
9. Low adult retarded		R	22.2	22.6	22.4	
		D	22.5	24.7	23.1	
	Color	R		NS	NS	No
		D			NS	No
	Form	R			NS	No
		D			NS	No

*For significance at the .05 level **For significance at the .01 level

The use of color, form, and size in sorting front-oriented identities and progressions within each group

Group 1 (high average grade 3). Table 6b shows that both regular and discrimination subjects of high average grade 3 do not have significantly different color, form, and size scores for front identities. This means that the subjects were not significantly dominated by any one of these characteristics in their vertical groupings (identities) of the stimulus objects.

In vertical progressions the regular subjects sorted the objects significantly more on the basis of different (progressions) color than on different size but not significantly more than different form. The discrimination subjects show no significant preference for any one of these stimulus characteristics in their sorting of differences (progressions).

Group 2 (low average grade 3). The regular subjects of low average grade 3 reveal that they responded to size significantly more on the basis of likeness (identities) in their vertical sorting, than they did form and color, as seen in Table 6b. The discrimination subjects show the same tendency except their response to size was not significantly different than their response to form.

In vertical progressions, the regular subjects show the reverse by significantly sorting more color differences (progressions) than size and more form differences than size. The discrimination subjects show they were not significantly influenced by any one of these characteristics (color, form, and size) in sorting differences.

Group 3 (superior grade 6). Table 6b indicates that regular and discrimination subjects of superior grade 6 did not significantly differ in their horizontal sortings of color, form, and size identities. This

shows that they did not respond preferentially to identical color, form, or size identities.

The scores of regular and discrimination subjects in vertical differences (progressions) also indicates a lack of preference for differences in color, form, or size.

Group 4 (high average grade 6). The regular and discrimination subjects of high average grade 6 show no significant preferences in their vertical sorting of identities, as seen in Table 6b. This means they did not respond differently to the likenesses of color, form, or size.

In sorting vertical progressions the differences in form were responded significantly more to than color and size differences by the regular subjects. The discrimination subjects did not significantly vary their responses to color, form, and size differences.

Group 5 (low average grade 6). Table 6b indicates that regular and discrimination subjects in low average grade 6 did not respond differently to color, form, and size in sorting likenesses (identities) and differences (progressions) of the stimulus objects in the vertical dimension.

Group 6 (high adolescent retardates). The regular and discrimination subjects of the high adolescent groups did not show significant preferences in sorting color, form, and size on likenesses (identities) and differences (progressions) on the vertical dimension.

Group 7 (low adolescent retardates). As shown in Table 6b, the scores of the regular subjects in the low adolescent retarded group do not significantly differ in their sortings of the stimulus objects on likenesses (identities) in the vertical dimension. This indicates that

any one characteristic (color, form, or size) was not grouped (identities) more than others in their sortings. The discrimination subjects of this group show significantly more response to size than color in grouping (identities) of the objects.

Regular and discrimination subjects did not respond to color, form, and size differently in sorting the objects on differences (progressions) in the vertical dimension.

Group 8 (high adult retardates). As indicated in Table 6b, the low retarded regular subjects scored significantly higher on size than color and form in sorting the stimulus objects on likenesses (identities). This means that their perceptions were dominated by identical size more than identical color or form. The discrimination subjects show they were not dominated by any one characteristic in their sorting of identities.

In the sorting of differences (progressions) of the stimulus objects the regular and discrimination subjects show no significant preferences for color, form, and size.

Group 9 (low adult retardates). Table 6b shows that the likenesses (identity) scores for the regular low adult retardates show a significant preference for form over color and size in their vertical sortings. This indicates a response to identical form characteristics significantly more than identical color and size characteristics. The discriminination subjects show no such differential response to color, form, or size when grouping the stimulus objects on identical characteristics (identities).

In their sorting of differences (progressions), the regular and discrimination subjects of this group did not respond differently to

color, form, and size. This is shown by the lack of significance in their front-oriented progression scores. The general finding of less significance here may be related to the lack of structuring in this dimension. The incomplete mental systems are reflected in more or less random patterns.

Concrete responses to size

Table 7 indicates the placement of the large objects in the top and bottom trays of the sorting matrix. These scores are expressed as means for all nine groups.

The occurrence of the large stimulus objects in the top and bottom trays was tabulated to measure for "concrete" responses. The tendency to use the larger easier to pick up objects first by placing them in the top tray is a measure of Piaget's pre-operational and concrete stages of development. The following conclusions can be drawn from Table 7.

1. All nine groups (regular and discrimination) sorted significantly more large objects into the top tray than the bottom tray.

2. The increasing chronological ages of the groups from (9.0 in group 1 to 20.6 in group 9) did not affect the top-bottom tray ratio of large object placements.

3. The mean large object placements in the top teay by the intellectually normal groups (1 through 5) was 5.0 compared to 4.5 for the retarded groups (6 through 7). This indicates that IQ did not affect the top-bottom tray ratio of large object placements. This finding is in disagreement with the well accepted belief that retarded subjects are more "concrete" than intellectually normal subjects.

Table 7. Top-bottom ratio for large objects

Group	Large objects		
	Top	Bottom	
1. High average grade 3	4.9	1.5	
2. Low average grade 3	5.5	1.2	
3. Superior grade 6	5.3	1.2	
4. High average grade 6	4.6	2.0	
5. Low average grade 6	5.1	1.8	
	Mean of normals		5.0
6. High adolescent retarded	4.4	2.9	
7. Low adolescent retarded	4.0	.26	
8. High adult retarded	4.7	1.6	
9. Low adult retarded	4.0	2.2	
	Mean of retarded		4.5

Summary of Findings

The purpose of this section is to complete the description of gindings and relate them to the two basic objectives of the study. The first objective is to (1) compare nine groups of subjects composed of intellectually normal children, mentally retarded adolescents and mentally retarded adults on a three dimensional classification task, and (2) determine the effects of discrimination training on the performance of the nine groups with the three dimensional task.

Top-oriented (horizontal) and front-oriented (vertical) organization of color, form, and size by the intellectually normal groups

In analyzing the top-oriented (horizontal) and front-oriented (vertical) organization of the stimulus objects by the five intellectually normal groups on the basis of color shade, form, and size, no significant differences were found. In this analysis of variance, color shade was considered separately, form considered separately, and size considered separately across all of the five groups to test for statistically significant differences. The results indicated no significant differences among the groups in the following.

1. Horizontal and vertical identities: In the grouping (identities) of identical color shades, identical forms, and identical sizes horizontally as well as vertically.

2. Horizontal and vertical progressions: In the sorting of different (progressions) color shades, different forms, and different sizes horizontally as well as vertically.

The use of the two directions (left to right and front to back) in top-oriented (horizontal) and front-oriented (vertical) sorting of the stimulus objects by the five intellectually normal groups

In the use of the two directions in top-oriented (horizontal) and front-oriented (vertical) sorting no statistically significant differences were found among the groups when each element (color shade, form, and size) was considered separately across the five normal groups. No significant difference applies among the groups in the following.

1. Left to right horizontal and vertical identities: In the grouping (identities) of identical color shades, identical forms, and identical sizes horizontally from left to right as well as

vertically from left to right.

2. Left to right horizontal and vertical progressions: In the sorting of different (progressions) color shades, different forms, and different sizes horizontally among the trays from left to right as well as vertically from left to right.

3. Front to back horizontal and top to bottom vertical identities: In the grouping (identities) of identical color shades, identical forms and identical sizes horizontally from front to back as well as vertically from top to bottom.

4. Front to back horizontal and top to bottom vertical progressions: In the sorting of different (progressions) color shades, different forms and different sizes horizontally from front to back as well as vertically from top to bottom.

In comparing the use of the two directions (left to right versus front to back) by the five normal groups considered as a unit the following can be stated.

1. Left to right vs. front to back horizontal identities: The groups used both directions about equally in grouping identical color shades, identical forms, and identical sizes horizontally.

2. Left to right vs. front to back horizontal and vertical progressions: The groups used both directions about equally in sorting different (progressions) color shades, different forms, and different sizes horizontally as well as vertically.

3. Left to right vs. top to bottom vertical identities: The groups used the top to bottom direction in grouping (identities) identical color shades more than the left to right direction. The groups used the left to right direction more in grouping identical

sizes vertically.

4. Use of front to back vs. left to right directions within groups: There were no statistically significant differences within each separate normal group between the use of the left to right direction versus the front to back direction in grouping identical color shades considered separately, identical forms considered separately, and identical sizes considered separately. This lack of significance was true in the relative use of these directions in sorting different (progressions) color shades, different forms and different sizes when each of these elements was considered separately. This lack of significance between the use of the two directions also applies to sorting different (progressions) color shades vertically, but in grouping (identities) identical forms and identical and different sizes vertically significant differences were found. Two groups at the same grade level, high and low grades 6, used the left to right direction significantly more than the top to bottom direction in grouping identical forms vertically. In the grouping of identical sizes vertically, three groups, high and low grades 3 and superior grade 6, used the left to right direction significantly more than the top to bottom, but in sorting different sizes vertically these same three groups, plus two retarded groups, used the top to bottom direction significantly more. These significant differences provide strong evidence that size is perceptually oriented more in an up-down relation than in a left to right for these normal groups. A factor to consider also in sorting of size is that all the groups (normal and retarded) sorted significantly more large sizes in the top tray than the bottom tray.

Top-oriented (horizontal) and front-oriented (vertical) organization of color, form, and size (considered separately) by the retarded groups

There were no statistically significant differences among the four retarded groups (regular and discrimination combined) in their top-oriented (horizontal) and their front-oriented (vertical) organization of the stimulus objects when each element (color, form, and size) was compared across all four groups in both dimensions (horizontal and vertical separately) by analysis of variance. The no significance differences conclusions can be applied in the following cases for the retarded.

1. Horizontal and vertical identities: In grouping (identities) of identical color shades, identical forms and identical sizes horizontally as well as vertically.

2. Horizontal and vertical progressions: In sorting of different (progressions) color shades, different forms, and different sizes horizontally as well as vertically.

The use of the two directions (left to right and front to back) in top-oriented (horizontal) and front-oriented (vertical) sorting of the stimulus objects by the four retarded groups

In the use of the two directions (left to right and front to back) by the four retarded groups, it can be stated that the groups showed no statistically significant differences when each of the elements was compared across all four of the groups. The no significance conclusion applies to the following.

1. Left to right horizontal and vertical identities: In the grouping (identities) of identical color shades, identical forms, and identical sizes horizontally as well as vertically from left to right.

2. Left to right horizontal and vertical progressions: In the sorting of different (progressions) color shades, different forms and different sizes horizontally as well as vertically from left to right.

3. Front to back horizontal and top to bottom vertical identities: In the grouping of identical color shades, identical forms and identical sizes horizontally from left to right and vertically from top to bottom.

4. Front to back horizontal and top to bottom vertical progressions: In the sorting of different (progressions) color shades, different forms and different sizes horizontally from front to back as well as vertically from top to bottom.

In comparing the use of the two directions (left to right versus front to back) by the four retarded groups considered as a unit the following applies:

1. Horizontal identities: The groups used both directions about equally in grouping (identities) identical color shades, identical forms and identical sizes horizontally.

2. Horizontal and vertical progressions: The groups used both directions about equally in sorting differences (progressions) in color shades, in forms, and in sizes horizontally as well as vertically.

3. Vertical identities: The groups used the left to right direction more than the top to bottom direction in horizontal grouping (identities) of identical color shades and identical sizes, but they used the top to bottom direction more for grouping identical form. This means that retarded groups were combining like color

and like size in the left to right direction and grouping like forms from top to bottom.

4. Use of front to back vs. left to right directions within each separate retarded group; Each of the four retarded groups did not significantly differ in their use of the left to right versus front to back directions in grouping (identities) and sorting differences (progressions) horizontally.

When each separate group is tested in their use of the left to right versus the front to back directions, vertically, significant differences were evident. In grouping identical color shades vertically, high adult retardates used the front to back direction significantly more. In grouping identical form vertically, two groups, low adolescent retardates and low adult retardates, used the left to right direction significantly more than the front to back direction. This implies that low IQ educable retardates prefer left to right over front to back in grouping forms vertically. In grouping sizes vertically the low adolescent and high adult retarded groups significantly used the left to right direction more than the front to back direction. This significant preference for the left to right direction for grouping both form and size strongly suggests that these retarded subjects may prefer this direction on the basis of training they have received in their sheltered workshop or in special classes they have attended. This direction is strongly encouraged by our culture in reading and in placing and sorting objects repetitively in sheltered workshops.

In the use of the two directions (left to right versus front to back) by each separate group in sorting different (progressions)

color shades vertically, no significant differences in each group were evident. This was also true for sorting different forms vertically, no significant differences in each group were evident. This was also true for sorting different forms vertically among the trays in each separate group but in sorting different sizes vertically, some significant differences occurred in three of the four retarded groups. Low adolescent retardates and high and low adult retardates used the front to back direction significantly more than the left to right direction in sorting different sizes horizontally among the trays. This strongly suggests that these retarded subjects use the top-bottom direction for sorting size differences vertically but, as previously mentioned, in sorting vertical size identities they use the left to right direction significantly more. This preference for the up-down direction for sorting vertical differences in size also occurred with intellectually normal groups, as previously mentioned, which indicates it may be a general preference with both normal and retarded subjects.

A comparison of the intellectually normal and retarded groups on the organization of top-oriented (horizontal) color, form, and size considered separately

A comparison of the five intellectually normal groups (regular and discrimination combined) and the four retarded groups (regular and discrimination combined) on top-oriented (horizontal) and front-oriented (vertical) organization of the stimulus objects indicates that the retarded and normal groups did not significantly differ in the following.

1. Horizontal and vertical identities: In grouping of identical color shades, identical forms, and identical sizes horizontally as

well as vertically.

2. Horizontal and vertical progressions: In the sorting of differences (progressions) color shades, different forms, and different sizes horizontally as well as vertically.

Comparing the use of the two directions (left to right and front to back) by the normal and retarded groups, the no significance differences conclusions applies to the following:

1. Left to right horizontal and vertical identities: In the grouping of identical color shades, identical forms and identical sizes horizontally from left to right as well as vertically from left to right.

2. Left to right horizontal and vertical progressions: In the sorting of different (progressions) color shades, different forms, and different sizes horizontally among the trays from left to right as well as vertically from left to right.

3. Front to back horizontal and top to bottom vertical identities: In the grouping (identities) of identical color shades, identical forms, and identical sizes horizontally from front to back as well as vertically from top to bottom.

4. Front to back horizontal and top to bottom vertical progressions: In the sorting of different (progressions) color shades, different forms, and different sizes horizontally from front to back as well as vertically from top to bottom.

A comparison of identities versus progressions in the sorting of top-oriented vertical identities and progressions by the normal and retarded groups

In regard to the sorting of the stimulus objects horizontally (top-oriented) and vertically (front-oriented) on the basis of identical

(identities) and differences (progressions) the following can be concluded.

1. Identities vs. progressions, color shades. All normal and retarded groups (regular and discrimination) sorted color significantly more on the basis of different color shades (progressions) than on the basis of identical (identities) color shades, both horizontally and vertically. They put different color shades together rather than like color shades together.

2. Identities vs. progressions, form. All normal and retarded groups (regular and discrimination) sorted form significantly more on the basis of different (progressions) forms than on the basis of identical (identities) forms in the vertical dimension and clearly but not significantly on the basis of different form in the horizontal dimension. They put different forms together rather than like forms together. The low adolescent retardates proved an exception in the horizontal dimension by grouping (identities) forms more on identities than on differences (progressions).

3. Identities vs. progressions, size. All normal and retarded groups (regular and discrimination) did a complete reversal from sorting on the basis of differences in color and form when they sorted size. The groups clearly shifted to grouping (identities) identical size in the front-oriented (horizontal) dimension. With size, they put like forms together rather than different forms together. While preference for sorting on the basis of size differences (progressions) decreased in front-oriented (vertical) dimension, it did not shift over to grouping on size likenesses as it did in the horizontal dimension.

A comparison of the use of top-oriented (horizontal) color, form, and size within each separate intellectually normal group and retarded group

The sorting of color, form, and size by each separate normal and retarded group in both front-oriented (vertical) identities and differences is shown in Table 8a and can be summarized by the following.

1. Horizontal identities in each normal group. In grouping the objects on the basis of identical elements horizontally (top-oriented), the intellectually normal groups responded significantly more to identical size, less to identical forms, and least to identical color. This significant preference for grouping size over color and form was also true for the discrimination subjects in the intellectually normal groups.

2. Horizontal identities in each retarded group. The retarded groups differed by responding more to identical form than to identical color and size in top-oriented (horizontal) identities. This preference was statistically significant for one of the four retarded groups (low adult retardates).

3. Horizontal identities in each retarded discrimination group. Discrimination training with the retarded group produced a noticeable result in top-oriented (horizontal) identity sorting. In the horizontal dimension the discrimination retarded subjects grouped more identical sizes than identical forms or identical colors, while the regular subjects of the retarded groups responded more to identical form. This implies that discrimination training increased the score of size likenesses (identities). This reversal to preference for size over form by the discrimination retardates was statistically significant in this horizontal dimension. This

Table 8a. Top-oriented identities and progressions: Mean top-oriented color, form, and size identity and progression scores for regular and discrimination subjects of each group

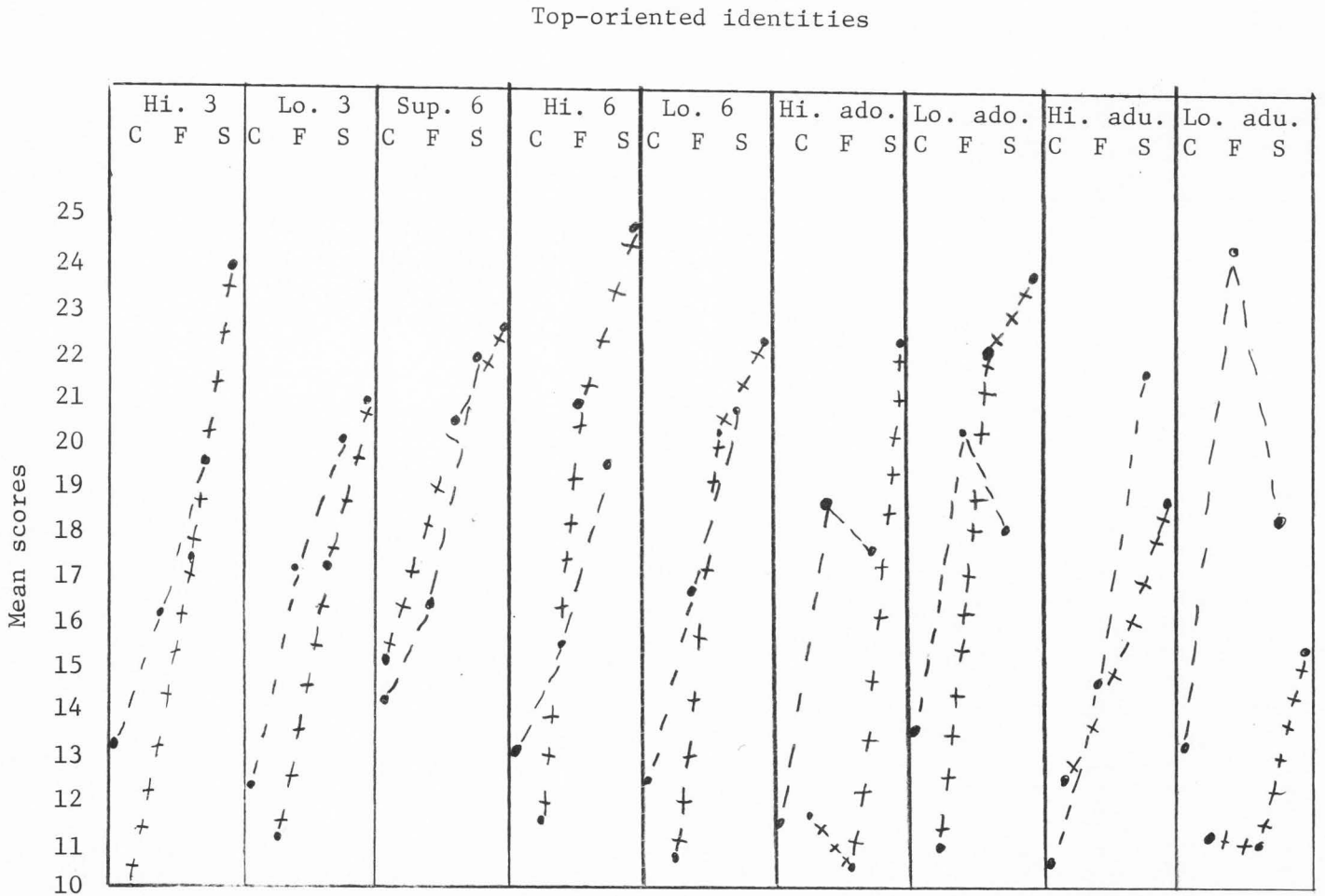
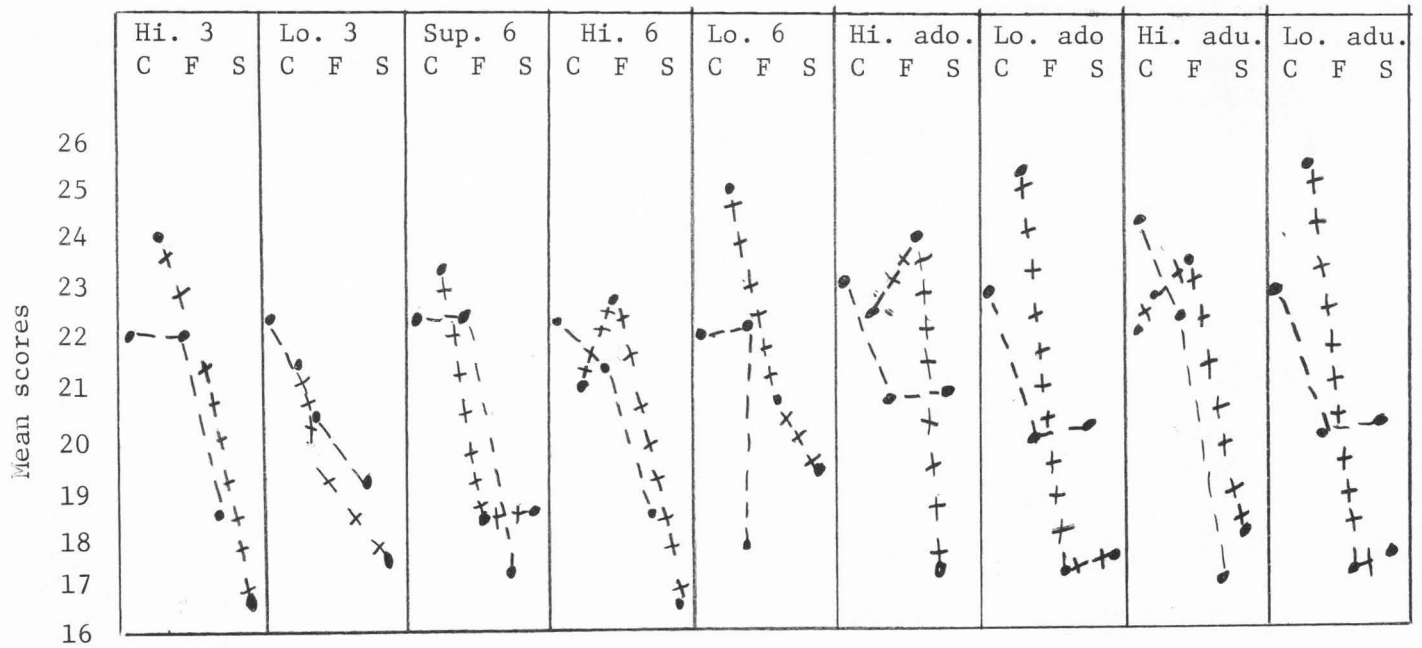


Table 8a. Continued

Top-oriented progressions



----regular subjects
++++discrimination subjects

reversal also implies that when given discrimination training retarded subjects will respond more like intellectually normal subjects by grouping size most, form less, and color least in the horizontal dimension.

4. Horizontal progressions, normal. The intellectually normal groups (regular and discrimination combined) showed a slight preference for responding to color differences (progressions) most, form differences slightly less and size differences least in the horizontal dimension but, in general, this preference was not statistically significant.

5. Horizontal progressions, retarded. The regular retarded subjects also showed a slight preference for responding to color differences most, form differences less, and size differences least, but only the high adolescent and high adult retardates showed this trend significantly.

A comparison of the use of front-oriented (vertical) color, form, and size within each separate intellectually normal group and each separate retarded group

The use of color, form, and size by each separate normal and retarded group in grouping (identities) and sorting differences (progressions) in the front-oriented (vertical) direction is shown in Table 8b and can be summarized by the following.

1. Vertical identities within each normal group. In sorting the stimulus objects on the basis of likenesses, vertically (identities), the intellectually normal groups responded most by grouping identical sizes, less to grouping identical forms, and least to grouping identical colors. This trend was not in general statistically

Table 8b. Front-oriented identities and progressions: Mean front-oriented color, form, and size identity and progression scores for regular and discrimination subjects of each group

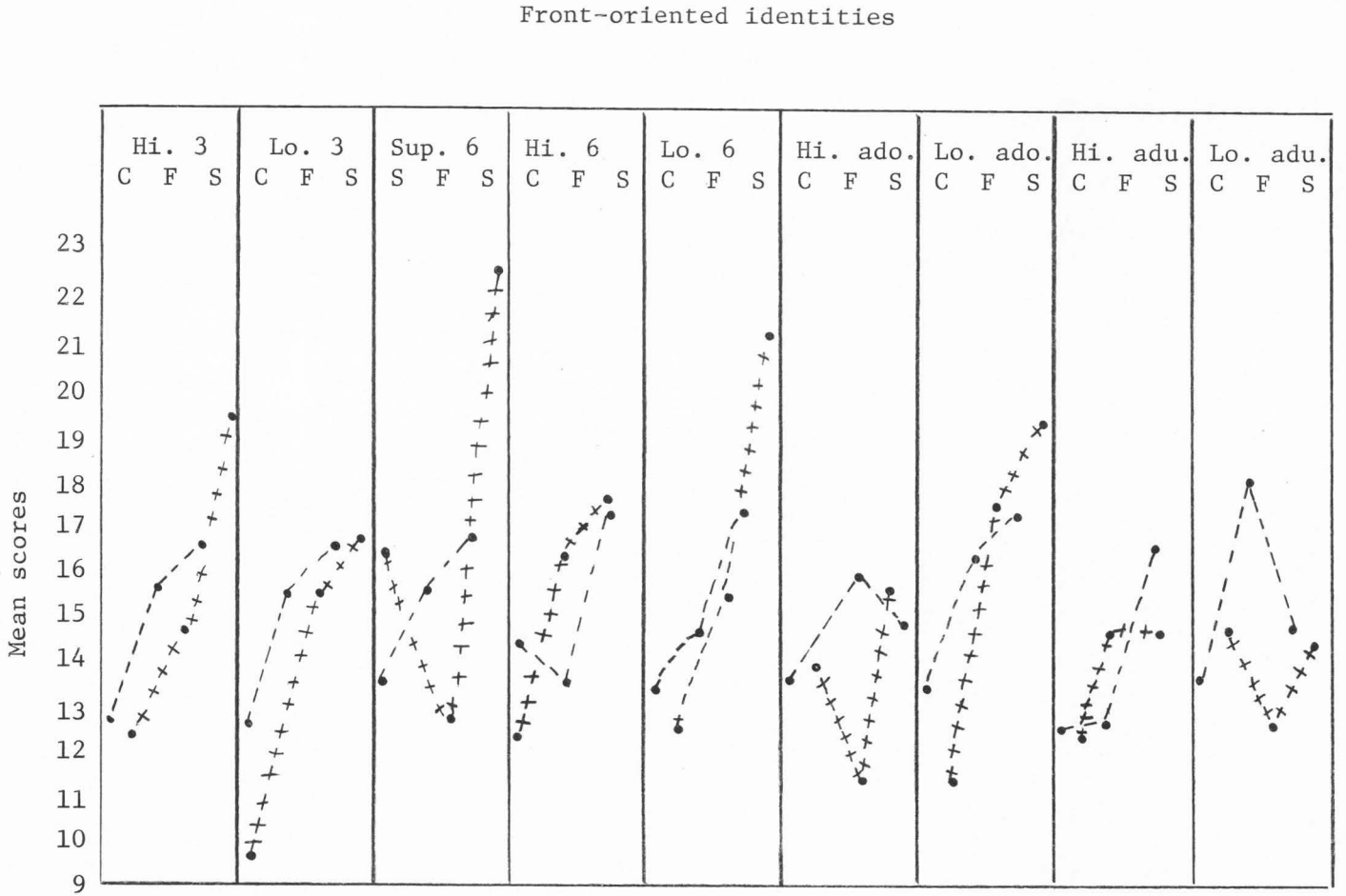
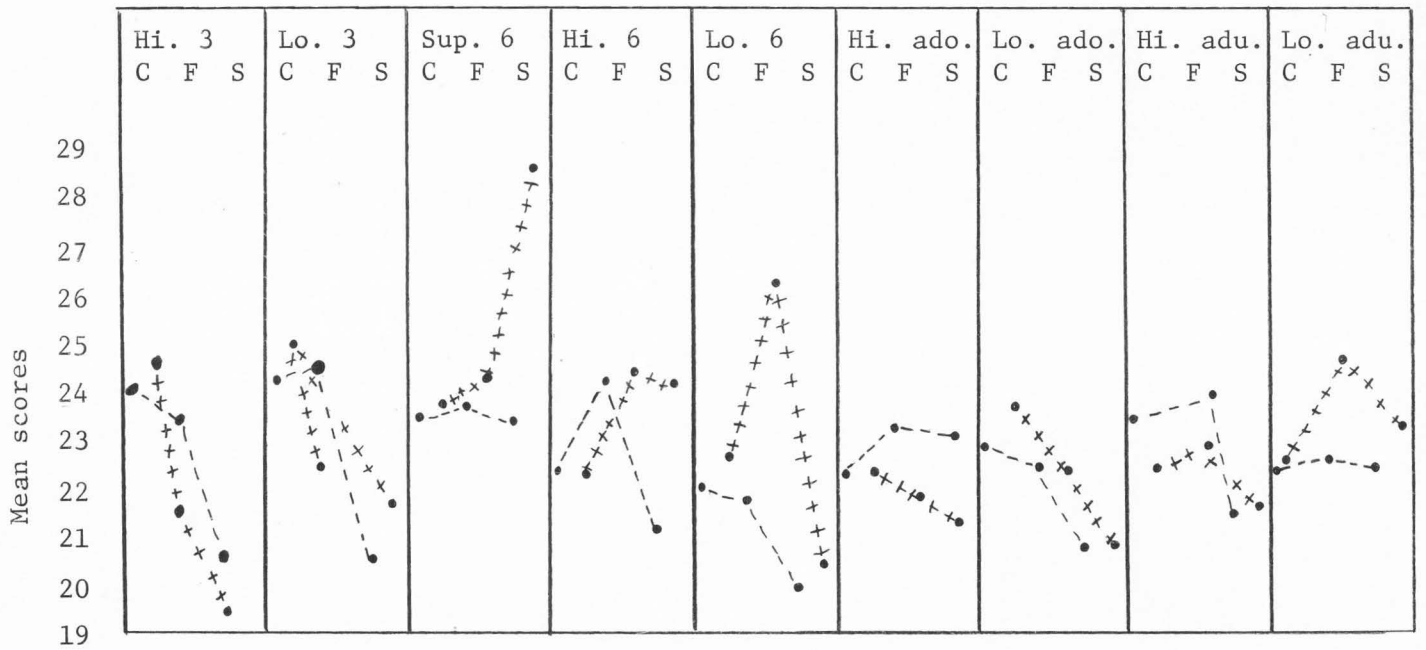


Table 8b. Continued

Front-oriented progressions



---Regular subjects
+++Discrimination subjects

significant.

2. Vertical identities within each retarded group. The retarded groups differed in their response to likenesses of the objects. Two groups (low adolescent and high adult) responded most to size and the other two groups (high adolescent and low adult) responded most to form, and all groups responded least to color.

3. Vertical identities within discrimination retardates. The reversal of the discrimination retarded subjects to sorting size identities most in the top-oriented (horizontal) identities also occurred in grouping front-oriented identities. This indicates that in both horizontal and vertical grouping of identities, discrimination training developed a reversal from preferring form most, as in the regular retarded subjects, to preferring size most as in the intellectually normal subjects.

4. Vertical progressions, normal and retarded. The intellectually normal and retarded groups (regular and discrimination combined) did not show significant preferences or clear trends in the sorting of color, form, or size differences (progressions) in the vertical dimension.

A comparison of the effects of discrimination training on the intellectually normal and retarded groups in sorting top-oriented (horizontal) color, form, and size

Table 9a shows the effects of discrimination training on the grouping (identities) of identical and different (progressions) color shades, forms, and sizes horizontally in the sorting matrix. The minus (-) marks in Table 9a indicate a decrease of 1.0 mean point or more from the score of the regular subjects of the same group who did not receive

Table 9a. A tabulation of positive and negative effects of discrimination training in the sorting of top-oriented identities and progressions

Groups	1	2	3	4	5	6	7	8	9
Identities:									
COLOR									
L-R	-	-				-			
F-B				-	-	+	-	+	-
FORM									
L-R	+			+	+	-		+	-
F-B	-		+	+	+	-	+	-	-
SIZE									
L-R	+		+	+	-	+	+	-	
F-B			-	+	+	+	+		-
MEAN		Normals = 3.2						Retarded = 2.0	
Progressions:									
COLOR									
L-R			+	-	+		+		
F-B	+				+		+	-	+
FORM									
L-R	-				+	+		-	+
F-B	+		-	+	-	+	-	+	+
SIZE									
L-R	-		-		+	-	-	+	
F-B		-	+	-		-	-	-	
MEAN		Normals = 1.8						Retarded = 2.3	

discrimination training and a plus (+) mark indicates a 1.0 or more increase over the regular subjects of the same group.

The comparative effects of discrimination training on the sorting of top-oriented identities and progressions by the intellectually normal and retarded groups can be summarized in the following manner.

1. Significance, normals vs. retardates. There were no statistically significant differences in the effect of discrimination training between normal groups and the retarded groups in top-oriented (horizontal) sortings. This lack of significance applies to the horizontal grouping (identities) of identical color shades considered separately, the grouping of identical forms considered separately, and the grouping of identical sizes considered separately. It also applies to the horizontal sorting of different (progressions) color shades, different forms, and different sizes when each is considered separately.

2. Identities, normals vs. retardates. Discrimination training as seen in Table 9a increased the grouping of horizontal identities in the normal groups (3.2) more than in the retarded groups (2.0).

3. Progressions, normals vs. retardates. Discrimination training produced a reversal in sorting in horizontal progressions by increasing the sorting of horizontal differences in the retarded groups (2.3) more than the normal groups (1.8) as seen in Table 9a.

4. Identities left to right and front to back. Discrimination training did not, in general, increase the grouping (identities) of identical color shades considered separately, identical forms considered separately, and identical sizes considered separately in one direction more than the other direction. This was true for the normal groups considered as a unit and the retarded groups considered as a unit.

5. Progressions left to right and front to back. As with horizontal identities above, discrimination training did not increase the use of one direction more than the other direction in

horizontal sorting of differences (progressions) in color shades, in forms, and in sizes. This was true for the normal groups considered as a unit and the retarded groups considered as a unit, as seen in Table 9a.

A comparison of the effects of discrimination training on the intellectually normal and retarded groups in sorting front-oriented (vertical) color, form, and size

Table 9b shows the effects of discrimination training on the grouping (identities) of identical and different (progressions) color shades, forms, and sizes on the vertical dimension in the sorting matrix.

The results of discrimination training in front-oriented sorting of identities and progressions by the intellectually normal groups (1-5) and the retarded groups (6-9) can be stated in the following manner.

1. Significance, normals vs. retardates. There were no statistically significant differences in the effects of discrimination training between normal and retarded groups in front-oriented (vertical) sortings. This was true for the vertical grouping (identities) identical color shades considered separately, for the grouping of identical forms considered separately and the grouping of identical sizes considered separately. In the vertical sorting of different (progressions) color shades, different forms, and different sizes, each considered separately, no significant effects were found between normal and retarded groups also.

2. Identities, normals vs. retardates. Discrimination training as seen in Table 9b increased the grouping of vertical identities in the normal groups (2.4) more than it did the retarded groups (1.8). Thus, normal groups were more affected by this treatment

Table 9b. A tabulation of positive and negative effects of discrimination training in the sorting of front-oriented identities and progressions

Groups	1	2	3	4	5	6	7	8	9
Identities:									
COLOR									
L-R	-	-			-	-	-		
F-B	+	-	+	-		+		+	+
FORM									
L-R	+		-	+	+	-		+	-
F-B	-	+	-		+		+		
SIZE									
L-R	+		+	+		+	+	-	
F-B		-	+	-	+				
MEAN		Normals = 2.4						Retarded = 1.8	
Progressions:									
COLOR									
L-R	+		+					-	
F-B	-		-				+	+	
FORM									
L-R	-	-			+	+		-	+
F-B		-	+		+	-			-
SIZE									
L-R	-				+	-	-	+	
F-B		+	-	+	-		+	-	
MEAN		Normals = 1.6						Retarded = 1.5	

than the retarded groups. This was also true in top-oriented identies (Table 9a) where the normals also changed more.

3. Progressions, normals vs. retardates. Discrimination training did not increase the vertical sorting of differences more in the normal (1.6) than in the retarded groups (1.5), as seen in Table 9b. Thus, neither group, normal or retarded, was affected more than the

other in this vertical dimension. This was not true in the horizontal sorting of differences (progressions) where the retarded benefitted, increasing their scores more than the normal groups.

4. Identities left to right and front to back. Discrimination training, in general, did not increase the vertical grouping (identities) of identical color shades, identical forms, and identical sizes, each considered separately, in one direction more than the other direction. This was true for the normal groups considered as a unit and for the retarded groups considered as a unit.

5. Progressions left to right and front to back. As with vertical identities above, discrimination training does not show trends to increase the use of one direction more than the other direction in sorting different color shades, different forms, and different sizes vertically. This is shown in Table 9b.

General concluding statement concerning the effects of discrimination training

The following general statement can be applied to the effects of discrimination training with the normal and retarded groups of this study.

1. Significance: In general, the effects of discrimination training on the normal and retarded groups were isolated and without statistical significance.

2. Most striking effect: The most striking result of discrimination training occurred with the retarded groups. In both the horizontal (top-oriented) and vertical (front-oriented) dimensions, the retarded discrimination subjects sorted more identical sizes than identical forms and colors while the regular subjects of the

retarded groups responded to different forms more than different sizes and different colors. This reversal to size by the discrimination training increased responsiveness to size and as a result of such training retardates responded like normal subjects who also sorted more on identical size than identical form and identical color.

3. Normals vs. retardates: There were isolated indications that the mentally retarded groups benefitted less from discrimination training than the intellectually normal groups.

Concrete responses to size

The results measuring the nine groups on "concrete" responses by tabulating their placements of the large objects in the top and bottom trays can be summarized in the following manner.

1. Top-bottom ratio: All nine groups (regular and discrimination) sorted significantly more large objects in the top tray than in the bottom tray.

2. Chronological age effects: The increasing chronological ages of the groups (from 9.0 in group 1 to 20.6 in group 9) did not affect the top-bottom tray ratio of large object placements.

3. IQ effects: The retarded groups (regular and discrimination) did not place more large objects in the top tray than the intellectually normal groups (regular and discrimination). This indicates that IQ level did not determine the top-bottom tray ratio of large objects. This finding is in disagreement with the well accepted belief that retarded subjects are more "concrete" than intellectually normal subjects.

DISCUSSION

The Concept of Structure

Maturity and increasing formal structure

The reader will recall from the Review of Literature, that in Piagetian terms, formal structure involves a system. In this context the system involves the simultaneous "taking into account" of color, form, and size in three dimensions.

Simple elementary solutions "center" or "focus" on parts of the total possible structure. For example, a student might put similar sizes together and disregard shape or color. If so, his identity score for size would be high, and for shape or color would be random. The random base problem is a recognition that with 27 objects, any one object, one cell sorting will produce some plus (+) scores. In other words, there is "true zero." This implies a relative zero, or random base score as a starting point.

On the other end of the problem is the attempt to logically define a "perfect" adult solution.

In between, we would expect to find maturational differences in choosing identities and also in choosing different colors, sizes, and forms which are scored in this study as progressions.

Because so much basic research is needed, one study can only begin to answer some of these problems. In this case, it was desired to begin the exploration of differences between normal and mentally retarded groups. This comparison will eventually be aided by further research aimed to carefully describe the developmental changes which are occurring.

A limitation, then, is that the comparisons made here are rather coarse, since only selected groups were used.

How the "perfect" solution aids in interpreting the data

If the researcher has a "perfect" solution in mind, he may be better able to interpret trends for the reader. One immediate problem has to do with the fact that as structure increases, some scores in some dimentions move to zero. In other words, general structural improvement may result in certain zero scores. This means that the untrained reader may misinterpret some results as no ability which really reflect considerable formal structure.

In this study, however, the possibility of the perfect solution was so limited that this problem occurs in no significant way. The general differences in scores reflect variation and growth, but only on a rather primitive basis.

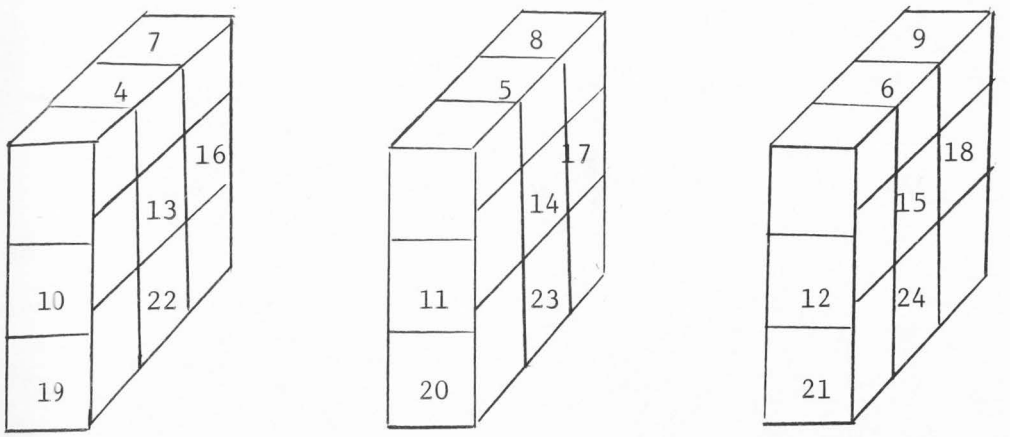


Figure 16. Front view of the three dimensional matrix used in illustrating a perfect solution.

In the example given in Figure 16, if scoring for color identity (horizontal) the left to right scores for cell 1-2-3, 4-5-6, and 7-8-9 are 9, since all are alike (all light). At the same time, if scoring (vertical) is done for color in the front face, the front to back color identity score is zero. Of course, the progressions score here is nine since the full range of differences occur (Figure 17).

1	2	3
10	11	12
19	20	21

Figure 17. Front face of the three dimensional matrix scored for vertical color.

The feasibility of scoring pre-perfect structure

The rather low scores in this study have shown limited structure. Hence, by looking at horizontal and vertical solutions separately, we may observe degrees of identity or progression scores in these dimensions.

Since the subjects had free choice as to direction, we may gain

considerable practical information as to which choices they were making without becoming unnecessarily involved in theoretical perfect structure.

Interpretation of findings

The findings must be interpreted tentavely in exploratory research such as this because of three subtle factors:

1. The gradual development of any structure at all. This may be confused in some comparisons with counter-balanced structure.
2. The point at which any structure begins to blend with counter-balanced structure.
3. The advanced point at which a truly systematic structure produces "structure-related zeros," as compared to "random scores" and "relative zeros."

Relation of This Study to Other Studies of Concept Formation

As the reader will recall, Stone (1965) was the first experimenter to use concurrent categorization in the study of concept formation. This approach was effective in fulfilling his three objectives:

> To (1) describe the developmental stages in age-level responses to color, form, and size, (2) to utilize the Bruner and Piaget systems to describe the stages, and (3) to observe if the stages are related to verbal and non-verbal aptitudes. (Stone, 1965, p. 501)

In several respects Stone's study resembled the present study. Both required their subjects to sort objects varying in color, size and form into a three dimensional sorting matrix consisting of moveable trays. Also, both studies had similar task instructions to the subjects which alloved them freedom to sort the objects as they wished, and both studies gave special discrimination training to subjects of each group to test

the effects of such treatment on sorting.

The objectives of the present study to (1) study nine diverse groups of normal and retarded adolescent and adult subjects on a three dimensional sorting task and (2) study the effects of discrimination training on the object sorting of the nine diverse groups were very similar to Stone's objectives, but dissimilar enough to require different task objects, different subjects, different scoring, and different cueing.

Stone used 54 objects of 6 kinds and 3 colors (black, white, and yellow) which required a larger three dimensional matrix. The need for the subjects to consider three more kinds of objects which resulted in 54 objects compared to the present study's 27 made it a more difficult task because it required the subjects to consider more instances in their sortings. The present study decreased the number of kinds of objects to three familiar objects, cube, sphere, and tetrahedron. This change and the use of three shades of blue, rather than the three distinct colors (black, white, and yellow) were accomodations for the four mentally retarded groups who may have been overwhelmed by the additional stimuli. By choosing subjects from grades 1 through 9, Stone was able to study the "developmental aspects" of concurrent categorization in Piagetian terms. This objective differed from the present study which studied the differences in diverse groups of intellectually normal, adolescent retarded and adult retarded.

Stone's use of cueing also had a different objective. He preplaced two cues in the matrix to structure a basis for the one correct solution of his problem. If used correctly, the cues forced the subjects to develop a logical "formal" structure, in Piagetian terms, for the solution of the problem which over-rode their "concrete" orientations to

the stimuli. As with the present study, Stone encouraged the subjects to sort the objects according to their desires in an attempt to study more "natural" conceptual development. Inclusion of verbalizations which could have influenced sortings were guarded against to encourage "natural" sortings. The one cue in the present study was of less importance than Stone's cues; it only served as an anchor point for the subjects' sortings to provide an orientation rather than to provide a basis for studying the "developmental" aspects of formal structure. The present study was certainly interested in the appearance of "formal structure," however, but it was not a specific objective for study.

The scoring formulas of the two studies were similar but they do not lend to direct comparisons of results. An important difference in scoring was that Stone awarded additional points as the subjects moved toward the one correct solution. The present study allowed for a more "natural" response to unstructured space.

The consideration of the effects of discrimination training on concept formation was an important part of both studies. Stone gave this training to 10 subjects (20 percent) in each group of 50 and to special grade 9 group of 20 subjects and a special adult group of 28 subjects to establish some upper parameters. The present study administered training to seven subjects (33 percent) of each group of 21 and 10 subjects (33 percent) in each of the two groups of 30 to study its effects. This training consisted of the same elements in each study but its effects were different, as a later section will reveal.

The influence of sex on concept formation was found to be negative in Stone's study and in other studies (Silverstein and Mohan, 1963; and Clark and Thompson, 1964) so the present study did not study this aspect.

Stone also studied the relationship between language IQ, non-language IQ and concept formation. In the present study, the effects of IQ on concept formation was not studied by correlations but it will be discussed in a following section.

With the similarities and differences of the two studies reviewed, a comparison of their findings should have more meaning and interest for the reader. As a means of comparison, the findings of Stone's study are given as a basis for comparing the two studies.

1. Scoreable responses developed by increasing age in the order of color, then size, and then form.

This developmental approach was not part of the present study where diverse groups were compared, but the comparisons across the groups revealed no significant differences among the groups in the horizontal and vertical grouping (identities) of identical color shades, identical forms, and identical sizes when each element was compared individually across the groups. This lack of significance also occurred in the sorting of differences (progressions) in color shade, form, and size across all of the nine groups. These findings of the two studies disagree but when the differences in the experimental populations are considered, it is evident that Stone's study was designed to detect the appearances and growth of sortings of color, form, and size across his groups while the present study was designed to consider differences among the groups.

In relation to the use of color, form, and size in the present study, it was found that the intellectually normal subjects responded significantly more to the likenesses in size in their horizontal and vertical sortings, than to likenesses in form and to color likenesses. This pattern did not change throughout high average grade, low average

grade 3, superior grade 6, high average grade 6 and low average grade 6 which indicates IQ and chronological age in these normal subjects did not affect these tendencies to respond in this way.

In horizontal sorting of differences (progressions) all the groups (normal and retarded) responded most to color. This preference does not show a developmental trend based on IQ or chronological age either.

The retarded groups showed a different trend by responding more to likenesses in form than to likenesses in size and likenesses in color. This also occurred in two of the four retarded groups in vertical sorting. This switch to responding more to form than size could be a function of their mental retardation or their older chronological age, their educational and training experiences or some combination of these factors. Discrimination training with these retarded subjects had an important effect. Rather than respond to form most like the non-discrimination retardates, they responded most to size likenesses as did the intellectually normal subjects.

Stone found the following in reference to horizontal and vertical organization:

2. Horizontal organization preceded vertical organization. This could have reflected the structure of the sorting matrix, which pivoted in a horizontal plane.

As the reader will recall, the present study was not designed to study developmental (growth) of the variables. As a result, data on the appearance and growth of horizontal and vertical organization is not available in the present study. Rather than study horizontal versus vertical development the present study investigated the use of the left to right and the front to back directions in sorting the objects

horizontally and vertically. The results of this aspect indicated no significant differences among the groups (retarded and normals) in their use of each direction considered separately for sorting color shade, form, and size (each considered separately) horizontally as well as vertically.

It was assumed that all groups would use the left to right direction more than the front to back in their horizontal sortings. This assumption was based upon the left to right orientation of our American culture. Children are introduced to this orientation at an early age in reading, in games, and in other activities, and they constantly are reinforced by repetition throughout their school years. This also applies to the adolescent retardates in special public school classes who have reading and other academic subjects. It is also noticeable in the sheltered workshop where the adult retarded subjects were employed. Their simple job tasks such as sorting fish hooks in boxes required them to place a fish hook in each of about ten boxes placed in front of them by moving from left to right. Although a direct statistical comparison was not made, a comparison of the composite means for the normal groups in their left to right horizontal sortings versus their front to back horizontal sortings of color, form, and size considered separately indicated that they used both directions about equally in their overall sortings. This finding also applies to the retarded groups and it also applies when the normal groups considered as a unit was compared to the retardates considered as a unit.

In the vertical sorting of the objects down through the trays, some differences in the use of the two directions appeared in favor of the left to right direction in sorting form and size likenesses. In sorting

form and size differences in the vertical dimension, the top to bottom direction was used more than the left to right. The normal and retarded groups were alike in these directional preferences.

The fact that the left to right orientation was used comparatively more in vertical sorting than in horizontal sorting was a surprising outcome of this study and one that would merit further study.

Another result of the present study may be its most important finding. In horizontal and vertical sorting all the groups responded more to the differences in color than the likenesses in color by sorting significantly more color progressions than color identities. With form, all groups responded to differences more than likenesses, significantly in the vertical dimension and clearly in the horizontal dimension. In responding to horizontal size, however, a switch occurred from responding to differences to responding to likenesses in size. This switchover did not occur in the vertical dimension but the groups were moving in that direction as they did in the horizontal dimension. This switchover may be the result of discrimination training, especially in the retarded groups where Tables 6a and 6b show that discrimination training developed a switch from form to size identities both horizontally and vertically. It may also reflect the appearance of a "formal structure" that revealed itself in grouping like sizes. The fact that all of the groups responded by placing from 4 to 5.5 large objects in the top tray which has nine compartments, may indicate that it is the result of "concrete" responses that increased their size identity scores.

Stone's study also found the following in reference to chronological age.

3. Scores, in general, increased continuously with age, indicating

a gradual overriding of concrete responses by logical formal system control required for a complete solution.

The switchover from the sorting of color differences to form likenesses by the groups suggests that "formal structure" was developing but because no perfect solution was included in the present study, this can only be inferred. The findings of the present study indicated no significant differences among all the nine groups in color, form, and size scores when each score was considered separately. This shows that neither chronological age nor IQ affected the scores, but again the differences in subjects used by the two studies must be considered. If the present study would have included average or superior adults with discrimination training, formal structure may have occurred. Stone found that discrimination adults were using definitely more formal structure than his grade 1-9 subjects.

In specific reference to discrimination training effects, Stone found the following.

1. Discrimination training produced significant increases in performance. This implies that training may vary the emergence of solutions, rather than assuming that maturation to be the basic factor.

The findings of the present study indicate that discrimination groups did not significantly differ from the normal groups in any of the color, form, and size scores regardless of direction (left to right or front to back). The most important effect of this training occurred with the retarded groups when they switched grom grouping form likenesses (identities) to size likenesses in both the horizontal and vertical dimensions. Other than this important result, discrimination training effects were isolated and without trends. It is rather surprising

that such opposite results occurred in two treatments so similar. It was expected that the retarded groups would respond less to discrimination training than normal groups because of their inferior mental structure. There were some indications that this was true in their sortings in isolated instances but the no significant results of the analysis of variance indicates that such instances cannot be generalized. It is probable that discrimination training was not effective in the present study because of the reduced stimuli which were more simple than Stone's six kinds. This training may not have been needed to discriminate the three kinds of the present study. Discrimination effects may have been concealed because its results may have produced a relative increase in all elements without producing switchovers. It is difficult to predict what effects such training had on color shade discrimination. Stone used distinctly different colors (black, yellow, and white) which were easier to discriminate than the three blue color shades of the present study. It can be hypothesized that discrimination training would increase the discrimination of similar shades of one color by pointing out the differences but it may be that the subjects "focused" on the more obvious differences in form and size and disregarded the color shades. The fact that colors were sorted on differences significantly more than likenesses could be interpreted as a result of the subjects' inability to discriminate the three shades and then group them on likenesses. In Stone's study color was the first to appear organized as identities which indicates discrimination among his three colors occurred.

Stone's findings concerning cognitive development are given below.

1. Generally increasing scores at successive levels gave evidence

for progressive stages of cognitive development as described by Piaget.

The study of these factors were not an objective of the present study as indicated by the lack of a one correct solution. The "formal operational" level in which "logic" is used to structure a solution was not apparent in the present study but it may have been emerging as indicated by the switch to sorting size likenesses in the horizontal dimension. The subjects of the study could have been classifying on the basis of one element (preoperational) or two or three as in the concrete operational level. This is material for further investigation.

Stone found that large objects were responded to in a consistent manner by his groups.

1. Responses to large objects showed little decline until the adult level, indicating that the concrete quality response continues strongly during the period studied.

The results of the present study agree with the above findings. All groups from grade 3 to retarded adults sorted significantly more large objects in the top tray than the bottom tray. This indicates chronological age and IQ did not change this tendency.

In regards to the relation of language and non-language IQ to performance, Stone found the following.

1. A correlation of .04 overall for language aptitude and performance and a .14 overall correlation for non-language and performance.

The present study found no significant differences among the groups in their sortings when each score was considered separately across all nine groups.

Both studies agree that IQ had non-significant effects on the performance of their subjects with their experimental tasks.

Implications of This Study

The implications of this study have been either implied or stated by the discussion section or the limitation section. They are further elaborated below.

1. The experimental task of this study has definite possibilities for the study of three dimensional categorizing with the mentally retarded. The study of Piagetian stages in mentally retarded could be accomplished by using larger groups of retardates with sequential stages of IQ or sequential stages of chronological age. The present task is simple enough for the retarded to work with but if Piagetian stages are studied, it may be necessary to increase the instructions to include questions about how to solve the problem which would be devised by pre-placed cues. Instructions would be needed to encourage "logical structure."

2. The effects of discrimination training with retardates should be investigated further. Merachnik's (1961) finding that age, sex, or type of retardation did not influence ability to discriminate small color saturations but that retardates were inferior to normals on these tasks, suggests that discrimination training specifically designed to increase color discrimination could have significant effects on the task of the present study. Another approach to the problem of color discrimination would be to eliminate it by using three distinctly different colors as Stone (1965) did in his study.

3. A further study of the effects of IQ on three dimensional categorization is needed. Stone (1965) controlled the effects of this variable by using covariance analysis. In correlating IQ with

performance, he found a low positive (.04) correlation between language IQ and performance and non-language (.14) and performance.

A study including normal groups with sequential increases in IQ to the highly superior IQ range on a pre-cued task requiring "logical structure" for solution would be an addition to the literature. The present study would probably have enough ceiling for such a study if the cues were no more than two in number. A study of this nature would require the establishment of a "random base" as a "relative zero" to compare the groups against.

4. The effects of increased instructions on the solving of a pre-cued problem requiring logical structure should be studied in both normal and retarded groups. Stone's study and the present study purposely used instructions that would not influence the subjects' sortings but the educational implications of a study which determined what type of training tends to induce "formal structure" at different age levels would be a definite contribution to the literature.

5. Certain findings of this study have educational implications. It is apparent that all of the nine groups responded more to size likenesses than form and color shade likenesses. This implies that children (grades 3 and 6) and adolescent retardates (grades 9 through 12) find identical sizes more interesting than different sizes and more interesting than identical colors and forms. A teacher in constructing educational materials may increase interest in classroom tasks by using identical sizes more than identical forms and colors for both normals and retardates.

It appears that if instruction in the physical features of objects

is to increase performance, it should be used with groups of objects that include several colors, forms, and sizes which appear complex. Discrimination training with stimuli that have only a few variations does not seem to increase performance.

Limitations of This Study

The findings of this study were limited by the following.

1. The findings of this study may have been limited by the small number of subjects in each group. Each group consisted of 21 subjects except the two groups of adolescent retardates who had 30 subjects. Seven of the 21 and 10 of the 30 received discrimination training so the regular groups were reduced to 14 and 20.

The experimenter was aware of the need for larger groups but the availability of non-institutionalized adolescent and adult retardates was so limited that the smaller groups were used. Also, this study was an exploratory investigation which was more interested in the differences in diverse normal and retarded groups in three dimensional concept formation.

2. The overall use of one direction (either left to right or front to back) versus the other direction by the nine groups considered as a unit, was not directly compared for significant differences in the sorting of color, form and size (each considered separately) in the horizontal dimension or in the vertical dimension. Instead, comparisons of the nine groups considered as a unit in the use of the two directions were made by comparing their composite means for each direction on color or form or size in each dimension separately (horizontal first then vertical). Comparisons within

each group in the use of these directions in their sorting of color, form, and size (considered separately) horizontally as well as vertically were made, however, by a test of the significance between the two means (one for each direction).

3. This study was limited to studying differences among groups rather than studying developmental growth of concept formation because of its diverse groups of subjects. Its experimental groups included two groups of third graders, three groups of sixth graders, two groups of adolescent retardates and two groups of adult retardates. These groups varied significantly in chronological age and IQ level which tended to cover developmental trends that would have probably emerged with groups who follow a developmental chronological age sequence or IQ sequence.

4. The use of the three blue color shades may have introduced a color discrimination effect that explains why all the nine normal and retarded groups (regular and discrimination) sorted significantly more on differences (progressions) than likenesses (identities). Care was taken to use three distinctly different shades of blue in coloring the objects and to administer the task under adequate lighting but the fact that discrimination training did not increase color groupings may indicate that three distinctly different colors should have been used in the study. This inability to discriminate the three blue color shades may have influenced discrimination training effects greatly.

5. Comparisons of the groups against a "relative zero" would have revealed whether the groups' sortings were significantly above chance, although the absence of high scores and the lack of

significance among the groups on each of the 24 scores indicates that such a comparison would have provided little useful data.

SUMMARY AND CONCLUSIONS

Introduction

This study was designed to investigate three dimensional concept formation in selected intellectually normal as compared to adolescent and adult retardates.

Bruner (1962) indicated that concept formation and cognitive studies, in general, have experienced a "revival" in recent years. He credits this increased interest to the inability of S-R theories to explain the events that occur between the stimulus input and the response in learning and to the advent of "ego psychology" in personality theory.

This study was undertaken to fulfill a need for a study in complex categorization processes comparing intellectually normal and retarded subjects. Historically, studies with both normal and retarded subjects have used simple sorting tasks such as the Goldstein-Scheerer Color Form and Object Sorting Tests. Only one other study, Stone's (1965), has employed a three dimensional experimental task which required the subjects to concurrently sort color, form, and size into a three dimensional matrix. The present study adopted Stone's three dimensional matrix but it reduced his number of objects from 54 to 27 and his kinds of objects from 6 to 3 to accomodate the retarded subjects. The inclusion of three blue color shades rather than three distinctly different colors (black, yellow, and white) was also made to adjust to the retardates' limited intellectual ability.

Statement of the Objectives

The objectives of this study were:

1. To compare nine groups of subjects composed of intellectually normal children, mentally retarded adolescent and mentally retarded adults on a three dimensional classification task.
2. To determine the effects of discrimination training on the performance of the nine groups with the three dimensional task.

Methods and Procedures

The five groups of intellectually normal subjects were students enrolled in grades three and grades six in the Cache County School District, Cache County, Utah, and in the Ogden City School District, Ogden, Utah. The retarded adolescent subjects were attending special classes in the Ogden City School District, Ogden, Utah, and the adult retardates were employed by "Laradon," a sheltered workshop in Denver, Colorado. Seven of the groups, high average and low average grade 3, superior high average, and low average grade 6, and high and low retarded adults consisted of 21 subjects. Two groups, high and low adolescent retardates, consisted of 30 subjects. One-third of the subjects in each group received special training designed to improve discrimination of the task objects. The regular and discrimination subjects of each group were comparable in IQ level.

All subjects were required to put the 27 objects into three moveable trays which were stacked on one another vertically but separated by one-sixteenth of an inch. Each tray held nine objects and could be moved on a pivot. The subjects were allowed to sort the objects of three kinds, sphere, cube, and tetrahedron; three sizes, 1-1/2, 1, and

1-3/4 inches; and three colors, dark blue, medium blue, and light blue, into the three dimensional matrix as they desired. The discrimination group also sorted the objects according to their own desires after they received orientation training with the objects and the matrix.

Scoring was based on grouping identical color shades, identical forms and identical sizes, which were called identity scores, and sorting different forms and different sizes which were called progression scores. The subjects' sortings were also scored in the horizontal dimension (top-oriented) and the vertical dimension (front-oriented). The use of left to right or front to back directions was also considered for both horizontal and vertical dimensions. A medium sized, medium blue cube was placed in the center compartment of the middle tray as a cue to provide an anchoring point for the subjects' sortings. Scoring formulas were stated and were used as an objective scoring system to insure reliability.

Findings

The findings related to the two objectives of the study are indicated as follows.

Horizontal and vertical identities and progressions

No significant differences were found among the groups in grouping (identities) of identical color shades, identical forms and identical sizes when each (color, form, and size) was considered separately across the groups. This was true for the horizontal dimension as well as the vertical dimension. This lack of significance among the groups also applies to the sorting of different (progressions) color shades, different forms, and different sizes when each was considered separately across

the groups in both the horizontal and the vertical dimension. These findings applied specifically to the following groups:

a. Among the five intellectually normal groups (regular and discrimination)

b. Among the four retarded groups (regular and discrimination)

c. Among all nine groups (normal and retarded).

The use of left to right and front to back directions

In the use of the two directions (left to right and front to back in the horizontal dimension and left to right and top to bottom in the vertical dimension) the following was found:

1. Horizontal and vertical use of the left to right and front to back directions: No significant differences were found among the groups in the use of the left to right direction for grouping (identities) identical color shades, identical forms, and identical sizes when each element (color, form, and size) was considered separately across the groups. This was true for the horizontal dimension as well as the vertical dimension. It was also true for the sorting of differences (progressions) in color shade, form, and size in each dimension. This lack of significance also applied to the front to back direction (top to bottom in vertical) where the sortings among the groups did not significantly differ in grouping the identical elements or in sorting the elements on differences when each element was considered separately. This finding of non-significance in the front to back direction applied to both horizontal and vertical dimensions. The above findings apply specifically to the following groups:

a. Among the five intellectually normal groups (regular and discrimination)

b. Among the four retarded groups (regular and discrimination)

c. Among all nine groups (normal and retarded).

2. Horizontal left to right direction versus the front to back direction: In the use of the two directions, the nine groups (normal and retarded) together did not use either direction more than the other direction in their horizontal grouping (identities) of the three elements when each element was considered separately. This was also true for the horizontal sorting of differences. This was found, also, within each separate group in the horizontal use of the two directions.

3. Vertical left to right versus the front to back direction: In the vertical grouping (identities) of identical elements the left to right direction was used more than the front to back direction in grouping form and size, but the front to back direction was used more in grouping identical color by the nine groups (normal and retarded) considered together. The reverse was true in sorting differences (progressions) where the front to back was used more than the left to right in sorting different forms and sizes. The nine groups showed no directional preference in sorting vertical color differences.

4. Vertical and horizontal use of the left to right and front to back directions within each separate group: There were no significant differences within each of the nine groups in the use of the two directions in horizontal grouping (identities) of identical

elements when each element was considered separately. This was also true for the sorting of differences horizontally. In the sorting of vertical identities and progressions, significant differences in the use of the two directions occurred within separate groups. Two retarded and two normal groups significantly preferred the front to back direction in sorting form identities and three normal and two retarded preferred the front to back direction for sorting size. These few isolated group findings do not indicate trends by either normal or retarded groups.

The sorting of identities versus progressions

In regard to horizontal and vertical sorting of identical (identities) versus differences (progressions) the following can be stated:

1. All nine groups (normal and retarded) sorted color significantly more on the basis of different (progressions) color shades than identical (identities) color shades both horizontally and vertically.

2. All nine groups (regular and discrimination) did a complete reversal in sorting size. The groups clearly shifted to grouping identical sizes together vertically. This reversal did not occur in the horizontal dimension but the progression scores for form indicated a strong tendency.

A sorting of top-oriented (horizontal) and front-oriented (vertical) color, form, and size within each separate normal and retarded group

1. Horizontal and vertical identities within each normal group: In grouping the objects on the basis of identical elements horizontally, the normal groups responded significantly more to identical

size, less to identical form, and least to identical color. This preference for identical size over form and color was also true for the discrimination subjects of the normal groups. In vertical identities, the same pattern of preferences occurred for likenesses in both normal, regular and discrimination, subjects but it was not, in general, statistically significant.

2. Horizontal and vertical identities within each retarded group: In the horizontal dimension three of the four retarded groups differed from the normal groups by responding most to form likenesses, less to size likenesses, and least to color likenesses. This preference for form was significant only in low adult retardates.

In vertical identities two retarded groups (low adolescent and high adult) responded to size likenesses most and color likenesses least as did the normal subjects but the other two (high adolescent and low adult) were consistent with their horizontal responses by responding to form likenesses most and color likenesses least.

3. Horizontal and vertical identities within discrimination groups: Discrimination training with the retarded groups produced a noticeable result in horizontal identity sorting. In the retarded discrimination subjects grouped (identities) more identical sizes than identical forms or identical colors, while the regular retarded subjects responded more to identical form. This switchover also occurred in the retardates in the vertical dimension in sorting identities. This reversal was statistically significant in the horizontal dimension and in one group in the vertical dimension. This reversal implies that when given discrimination training,

retarded subjects will respond more like intellectually normal subjects by grouping size identities most, form less, and color least.

4. Horizontal and vertical progressions of normal and retarded: The normal and retarded groups showed a slight preference for responding to color differences (progressions) most, form differences less and size differences least in the horizontal dimension but, in general, these preferences were not statistically significant.

In the vertical dimension all nine groups (normal and retarded) showed no significant preferences or clear trends in sorting color, form, and size differences.

The effects of discrimination training on the intellectually normal and retarded groups

1. Significance, normals versus retardates: There was no statistically significant differences in the effects of discrimination training. This lack of significance applies to horizontal grouping (identities) of identical color, identical form, and identical size when each is considered separately, and to the horizontal sorting of differences (progressions) in color, form, and size when each was considered separately. These findings also apply to vertical grouping (identities) and sorting of differences (progressions). Specifically the above findings apply to the following groups:

a. Among the five normal groups (regular and discrimination).

b. Among the four retarded groups (regular and discrimination).

c. Among all nine (regular and retarded groups).

2. Discrimination training effects for normal versus retarded groups: the normal subjects apparently increased their scores in more instances in horizontal and vertical grouping of identities than did the retarded groups. In horizontal sorting of progressions, the retarded subjects increased their scores in more instances more than the normal subjects. In vertical progressions both groups had a like number of increases. This indicates that discrimination training increased responses to likenesses in color, form, and size in normal subjects more than in retarded subjects. In response to differences, the retarded subjects are more affected by such training than the normal subjects. This indication that normal subjects respond more to discrimination training than retarded subjects is revealed by other isolated instances throughout this study.

3. Most striking effect: The most striking result of discrimination training occurred with the retarded discrimination groups when they switched from grouping identical forms to grouping identical sizes in both the horizontal and vertical dimensions. By switching to size, they responded like the normal groups but differently than the regular retarded subjects who remained with form. This indicates that discrimination training increased responsiveness to the element of identical size and developed a response identical to the responses of normal subjects.

Concrete responses to size

The nine groups (regular and discrimination) responses to the larger, more "concrete" objects can be summarized in the following

manner.

1. Top-bottom ratio: All nine groups sorted significantly more large objects in the top tray than the bottom tray. These larger "easier to pick up" objects were placed in the most available tray, the top tray.

2. Chronological age and IQ effects: The increasing chronological age (from 9.0 in group 1 to 20.6 in group 9) did not affect the top-bottom ratio of large object placements nor did the diverse IQ levels (range = 61.5-136.5).

Conclusions

The following conclusions can be stated from the findings of this study.

1. Normal school children (grades 3 and 6), adolescent educable retardates (grades 9 through 12) and adult non-institutionalized retardates do not significantly differ in their grouping of identical color shades, identical forms, and identical sizes in a three dimensional matrix when each of the three elements (color, form, and size) is considered separately across all of the normal and retarded groups. This lack of significance among the normal and retarded groups is also true for the sorting of different color shades, different forms, and different sizes when each of these is considered separately. All of the above findings apply to the horizontal sorting of objects in individual trays of a three dimensional matrix and in the vertical sorting of the objects down through a three dimensional matrix.

2. The normal school children (grades 3 and 6), retarded

adolescents, and non-institutionalized adult retardates do not significantly differ in their use of the left to right direction in their grouping of identical color shades, identical forms, and identical sizes when each element (color, form, and size) is considered separately across all of the normal and retarded groups horizontally as well as vertically in a three dimensional matrix. This lack of significance also applies to the use of the front to back direction in sorting differences in color shades, forms, and sizes (horizontally as well as vertically, top to bottom) when each element (color, form, and size) is compared in all of the normal and retarded groups.

3. Special training in discrimination of the task objects did not significantly affect the performance of the normal and retarded subjects of this study. This was true for horizontal grouping of the objects on identical as well as different elements and true for the vertical grouping of the objects on the identical as well as different elements. Adult and adolescent retarded groups showed noticeable effects from discrimination training by increasing their responses to size likenesses in their horizontal sorting of the objects. In general, normal subjects increased their grouping of identical elements more than retarded subjects from such training but the findings indicate that IQ and chronological age did not significantly affect discrimination training in the nine groups composed of diverse IQ and chronological ages.

4. The diverse normal and retarded groups of this study did not significantly differ in their "concrete responses" to the task objects. Chronological age and IQ did not significantly affect the

subjects' concrete tendency to choose the larger "easier to pick up" large size objects and place them into the top tray which was most accessible.

5. The results of this study were affected by the choice of diverse normal and retarded groups as subjects. Their wide IQ and chronological age differences prevented a systematic study of developmental trends in their responses to color, form, and size. Another limitation of this study was the small number of subjects in each group. Further research should consider the above limitations and the possibility of the effects of instructions to induce logical structures. The present exploratory study was designed to measure differences within its diverse groups rather than study developmental trends. The findings of this study should provide bases for further research.

Educational Implications of this Study

The findings of this study suggest the following educational implications:

1. The intellectually normal children from grades 3 and 6, and adolescent and adult retardates respond more to color and form differences than color and form likenesses. Therefore, assignments which involve objects of several different colors and different forms could be helpful in creating and maintaining interest and motivation.

2. Large sized objects more than smaller sized objects were responded to by intellectually normal children. This preference could be used to stimulate and maintain interest in school

assignments.

3. Special orientation training with objects of different colors, different forms, and different sizes should involve specific concrete instructions as to the possible uses of each object based on the object's distinguishing characteristics. Orientation based only on general characteristics of such objects does not seem to produce discrimination skills in intellectually normal children in grades 3 and 6, adolescent retardates, and adult retardates.

4. If different colors, different forms, and different sizes are to be used in teaching concept formation skills with intellectually normal children in grades 3 and 6, retarded adolescents, and retarded adults, specific directions designed to provide specific goals for their activities should be given so the subjects will have a basis for their sortings. This study implies that concept formation sortings do not appear spontaneously in these subjects.

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